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ENGINEERING NEWS.

NICARAGUA CANAL BORINGS of the great divide cut indicate that the entire cut d own to a depth of 165 ft. consists of solid basalt without crack or seam. If solid to this depth, it is almost certain to be equally solid for the small remaining depth, so that the general nature of the entire cut may be said to be determined. The result, of course, is the most favorable that could have been obtained, relieving all anxiety about the stability of the deep slopes.

THE BRITISH CHANNEL TUNNEL PROJECT has been emphatically condemned by Lord WOLSELEY, who prefers a bridge. The projectors, in reviewing this opinion, expressed their appreciation of the General's forethought; but pointed out the fact that a bridge could be as easily destroyed as a tunnel by the enemy. A bridge would cost ten times as much as a tunnel. Coal has been found in the experimental tunnel borings, and the tunnel advocates point out that there is a reasonable hope of developing this coal deposit and making it one of the most important discoveries of the age for England.

TEXAN HARBOR IMPROVEMENTS are to be pushed, at the Washington end, as a result of the late report of the Army Engineers. Senator COKE has already introduced a bill into Congress asking for $6,000,000 for Galveston. It is said that bills have also been prepared by the friends of the Corpus Christi and Padre Island project.

THE HUSTED RAPID TRANSIT BILL, about which there is now so much gossip, proposes to relieve both New York and Brooklyn, and would appoint seven commissioners, including the Mayors of the two cities. Briefly outlined, it proposes "to settle" the whole question of rapid transit, by selecting routes and selling them out to the highest bidders. The commission is to be a permanent one, to remain in office and see that the requirements are faithfully carried out. Tunnels under the East River are hinted at as a means of connecting the transport systems of the two great cities on each side. It is to be hoped that the Commission that this bill is supposed to require will have an engineer of ability upon it, or will, at least, be made up of men who have sufficient wisdom and regard for the public to employ experts of undoubted ability and experience in the discussion and selection of plans. The Board of Electrical Control will serve as an excellent example of "how not to do it."

THE STATEN ISLAND DRAWBRIDGE, built over the Arthur Kill by the Baltimore & Ohio Railroad, was formally opened to traffic on Dec. 19. This bridge crosses between Elizabethport, N. J., and Arlington, S. I. It was commenced in April, 1887, and completed June 13, 1888, but the opening has been delayed by litigation until now. The bridge is 800 ft. long over all, with two fixed spans of 150 ft. each and a draw span 521 ft. long. The clearance above high water is 32 ft., and the cost is stated at $500,000.

THE EAST JERSEY WATER COMPANY, says the *Newark Advertiser*, is reported to have purchased, for $1.00, large tracts of land in the Pequannock water-shed from the Bartlett syndicate. It is supposed that the reservoirs of the East Jersey Water Company are to be located somewhere on the lands bought. Mr. CLEMENS HERSCHEL, C. E., the Chief Engineer of the East Jersey Water Company, has his engineering office at Paterson, N. J.

PLAINFIELD, N. J., has made a contract with the Plainfield Water Co. to build and to operate for ten years a complete set of works. At the end of this time the city may renew for a similar term or purchase the works. The city agrees to pay the company a hydrant rental of $15 each for not less than 250 hydrants; and a uniform meter rate of not more than 15 cts. per 1,000 galls. is fixed in the contract, together with a tariff of annual rates for all uses of water. Wells will most probably be resorted to for a supply, and a daily flow of not less than 2,500,000 galls. is stipulated for. Plainfield is remarkable as being the largest town east of the Allegheny Mountains of its size (13,000 inhabitants) still without a public water supply. Mr. RUDOLPH HERING, C. E., is the Engineer.

THE LEASE OF THE WATER PRIVILEGES OF THE SCHUYLKILL CANAL is recommended by the Water Committee of the Councils of Philadelphia, as a means of additional supply. The price fixed is $300,000 per year for fifty years. As the scheme seems to propose simply the utilization of the several reservoirs of this company, and to convey the water to the city by the canal itself, it is difficult to realize a gain commensurate with the price to be paid. It is true that in past years Philadelphia has several times purchased water from the Canal Company, but this was only in seasons of great drought. There would be no improvement in the character of the supply. On the other hand, it would be a good thing for the Canal Company, which would thus rent at a fairly good price a property made almost valueless by the railroads on both sides of it. The proposition is likely to provoke a strong fight in the Councils.

THE AQUEDUCT COMMISSION and Commissioner of Public Works GILROY are having a squabble over the building of reservoirs in the Croton water-shed. Members of the Commission charge that Mr. GILROY has failed to supply them, as required by law, with plans and specifications for Reservoir D, near Carmel, and a water famine is predicted if these matters are not attended to more promptly. Commissioner GILROY denies the danger of a short supply, and says that his engineers have their hands full in caring for Reservoir M, and that he will not hire more men for work on Reservoir D.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Dec. 31, on the Chicago, St. Louis & Pittsburg Railroad (Panhandle road), near Kokomo, Ind., between two fast passenger trains. Both trains were late, and the conductor of the Chicago train took it for granted that the other train had arrived, and so started his train out of Kokomo without examining the train register. Three persons were killed and six injured. The loss to the railway companies is estimated at $25,000. Both engines were wrecked, and a smoking car and two baggage cars were burned. The accident was the result of the carelessness of the conductor in not looking after the movements of the train he was to pass. —A rear collision between two extra Michigan Central freight trains occurred on the Grand River bridge at St. Thomas, Ont., Jan. ; several cars were thrown into the river.—A passenger train on the Northern Pacific Railroad was derailed by a misplaced switch near Thompson Falls, Mont., Jan. 1 The baggage, smoking, and emigrant cars went down a thirty-foot bank to the river, but nobody was seriously injured. The baggage car caught fire, but the flames were soon extinguished.

SEVERAL BRIDGE AND TRESTLE ACCIDENTS are reported this week: On Jan. 3 the west span of the new Main-street bridge at Lafayette, Ind., gave way, owing to the failure of the false work, which was damaged by a flood. A correspondent says, "This work consisted of three spans of 180 ft. each; two spans are complete, and the third could have been made safe in twelve hours' time when the flood struck us. This span alone contained over 200,000 lbs. of iron, and is nearly a complete loss. The work was let to a local company, known as the Lafayette Bridge Co., and was built at the Variety Iron Works, of Cleveland, O."—A bridge on the San Antonio & Aransas Pass Railway, at Hallettsville, Ark., gave way under a freight train Jan. 2, and twenty-two cars were thrown into the river; three or four men were drowned.—An unfinished trestle on the Brierfield, Blocton & Birmingham Railroad, forty miles south of Birmingham, Ala., gave way Jan. 2, owing, apparently, to not being properly braced; it was 200 ft. long and 25 to 50 ft. high. Two men were killed and nearly twenty injured.—The fifth span of the iron bridge being built between South Hadley Falls and Holyoke, Mass., was blown down on Jan. 3; it was 165 ft. long. One man was killed and two were injured.—On Jan. 5, while a wrecking train was passing over a bridge on the Fall Brook Railroad, near Wellsboro, Pa., the derrick of the wrecker came in contact with the top of the bridge. The bridge broke and the cars went into the creek. Three men were killed and about ten were injured. This is said to be one of a series of wrecks on the Fall Brook road and a thorough investigation has been ordered by the coroner.—On Jan. 5, the bridge at North Columbus, O., over the Olentangy at Doddridge St., which was being constructed by the Columbus Bridge Co., was badly damaged by the drift which came down as a result of high water, and one span of the bridge was knocked down and another partially destroyed. An effort was being made by the employes of the company to keep the drift out of the way, but it came faster than they could handle it.—A temporary bridge on the Illinois Central Railroad, over East Fork, near Sandoval, Ill., which was built to replace one destroyed by fire, was carried away recently by a flood. A steel or iron bridge will be built.—The bridge of the Evansville & Richmond Railroad, over the White River at Seymour, Ind., has been destroyed.—The Spring St. foot-bridge over the canal at Windsor Locks, Conn., gave way recently.

THE HUDSON RIVER TUNNEL ACCIDENT of last Monday was caused apparently by a failure of the air-pressure to properly support the silt in the side of the tunnel, and several tons of material fell into the tunnel. Twenty-five men were inside at the time, and one of them was caught in the door of the air-lock "by the pressure of air and mud," and both of his legs and arms broken. Superintendent HASKINS denied that there was any serious accident or panic among the workmen; but he also practically admits that there was a "blow-out," or escape of air through the mud and silt. This was the "little incident" that preceded the terrible accident of several years ago.

A CAVE in a tunnel on the California & Oregon Railroad, near Redding, Cal., occurred Dec. 26. A car in the middle of a freight train had on board a snow-shovel derrick, which, being higher than the tunnel, struck the timbers, causing the cave.

THE BOILER OF A LOCOMOTIVE on the Baltimore & Ohio Railroad exploded Jan. 4, while the engine was at Benwood Junction, W. Va.

HEAVY RAINS have fallen in Arkansas, causing floods and several washouts. In central Illinois, the floods have carried away bridges, broken levees, and caused washouts.—A heavy snow slide occurred Jan. 3 at Sierra City, Cal.; five or six people were killed.

THE MERCHANTS' BRIDGE, at St. Louis, Mo., was "swung clear" of its falseworks in the last span on Dec. 28. This practically completes the river bridge. It is expected that the shore approaches will be completed in a few weeks.

THE PLANS FOR THE GREAT FALLS, MONT., DAM are said to be completed by Mr. J. T. FANNING the engineer. It will be built for the Great Falls Water Power & Town Site Co. across the Missouri River near the Black Eagle Falls. Judging from the meagre press accounts, it will be constructed of stone rip-rap faced with timber. Tenders for the work are now being received by Mr. FANNING.

A CAISSON ACCIDENT occurred on Jan. 9, at Pier 1 of the Louisville and Jeffersonville Bridge, now under construction over the Ohio River. The gangs were being shifted at the time, and as near as can be ascertained from the meagre press accounts, the accident, which cost the lives of fourteen men, was the result of leaving the doors in the supply shaft insecurely fastened, and to excavating too deep below the cutting-edge of the caisson. The air escaped rapidly at the supply shaft and water rushed in below, drowning fourteen out of eighteen men in the working chamber. The four who escaped managed to pass out of the supply shaft. The caisson was in 35 ft. of water at the time. The contractors for this part of the work were Sooysmith & Co., of New York.

BRICK STREET PAVEMENT, in Des Moines, Iowa, cost last year $1.75 per sq. yd., and City Engineer CHARLES BENNET commends it as "durable, healthy, smooth, clean and cheap." The city has 10,000 sq. yds. laid on its streets.

WIDER STREETS IN BOSTON are called for by the *Herald* of that city. The fact is pointed out that some Boston streets, only 30 ft. wide, are bounded by buildings 120 ft. high. Mayor QUINCY, in 1823, advised the widening and straightening of Washington St., from Cornhill to Boylston St., and it could then have been done for $200,000. This work would now cost millions. The wisdom of widening the streets in the district lately burned over is pointed out.

THE QUEEN'S COUNTY ROAD COMMISSION has approved the action of the last meeting of farmers and others interested, and fresh recommendations were considered at the Jamaica meeting of Dec. 28. Among these was one recommending the use of 3-in. tires on wagons hauling more than 4,000 lbs. of a load. This was adopted. The legislative committee is drafting a bill embodying the features suggested.

The Death Rate of New York City.

The following table shows the number and the cause of death in this city during the past year as compared with 1888:

	1889.	1888.
Estimated population	1,575,406	1,529,817
Total reported deaths	39,583	40,142
Death rate per 1,000 living	25.12	26.24
Smallpox	1	81
Measles	470	501
Scarlet fever	1,239	1,361
Diphtheria	1,685	1,914
Whooping cough	647	573
Typhoid and malarial fevers	626	634
Cerebro-spinal meningitis	144	173
Diarrhœal diseases	3,648	3,489
Heart diseases	1,967	1,871
Croup	603	639
Bronchitis	1,792	1,892
Pneumonia	4,015	4,288
Phthisis	5,163	5,360
Bright's disease, nephritis	2,428	2,342
Violence	1,467	1,485
Deaths under one year	10,678	10,411
Deaths under five years	17,051	'17,358

The violent deaths will be seen to aggregate 3.7 per cent. of the total deaths, or 6.5 per cent. of the total deaths over five years of age, the deaths under five reaching the appalling aggregate of 43 per cent. of the total deaths. Of the causes of violent deaths, suicides were 182, murders and homicides 51, falls 265, blows from falling objects 36, electricity 9, sunstroke 4, run over by horse cars 12, by cars and engines 33, by elevated trains 3, by wagons and trucks 32, poison 27, drowning 170, asphyxiation by gas 12.

The Brooklyn Bridge Terminal Plans.

By the decision of the Supreme Court noted last week, giving the trustees power to condemn land needed, the last known cause for further postponement of the actual carrying out of the adopted plans for the Brooklyn Bridge terminals has passed away, and we presume the necessary works will soon be undertaken. That our readers may see what these plans are, we reproduce from our issue of April 28, 1888, the accompanying illustration, showing the plan as it was when adopted, April 17, 1888. Since then no important or notable change has been made in the plan itself, but the claim then advanced, that it could be carried out without buying any more land, which was one of the arguments advanced in favor of the plan, has been since tacitly abandoned, and as a consequence the "adopted" plan has lain fallow for twenty-one months without even an attempt to carry it out.

As those of our readers who have taken an interest in the matter will remember, it is proposed that the tracks across the bridge shall be gauntleted, or laid in pairs close together, the northerly rails of each pair constituting one track, and the southerly of each pair the other track. In approaching the station from the bridge (on the left side of the cut) these gauntleted tracks split, passing one on each side of the incoming platform, which is thus entirely surrounded by tracks (as also the opposite outgoing platform) and accessible to passengers only from below. The first train passes, say, to the right side of the platform, and the next train while the first is unloading, passes to the left side, being on the other pair of gauntleted rails. A duplicate cable is proposed, one for each of the gauntleted tracks, and it is now proposed to do the switching likewise by cable. In this way it is claimed that trains can be run at 45 seconds headway, or just half the interval of 90 seconds which now obtains.

To do this it is at once evident that a train must pass over the crossing every 45 seconds, and that not at regular but irregular intervals. With locomotives used for switching, as now, this is a physical impossibility, it being necessary, to do it, that the crossing should be actually occupied by trains or engines more than 60 seconds in a minute. By omitting the switching engines, and relying on cables for switching as for propulsion, this physical impossibility disappears, but the crossing will still be occupied or threatened by a moving train almost constantly, a four-car train passing over it every 45 seconds. It is quite safe to say that no other crossing in the world has ever yet had such lively work over it, and as the crossing is situated on reversed 100-ft. radius curves, with crowded platforms within 50 ft. of it, on which panic may work terrible results in a few seconds, the dangers and disadvantages of such quick work over a crossing are intensified, not to speak of the added complications which will come from any attempt to switch the trains by cables.

It is a fact not generally known that, although locomotives are used only for switching, and all propulsion is by cable, the cost of the switching engines only is enormously greater than the whole cost of cable propulsion. In the year 1888, 91 per cent. of the car mileage was by cable, and only 9 per cent. by switching engines, notwithstanding which the cost of the cable was 39.3 per cent. only, or some $58,000 out of $148,000, the remaining $90,000 nearly all being for switching locomotives. Notwithstanding the fact that there has been, since the bridge opened, a ponderous unused plant for switching trains by cable at the New York terminus, the attempt to switch by cable over the present comparatively simple single system has never been successful. What is likely to be the effect of attempting to switch by cable over a complicated double system like that illustrated?

We trust the Board of Trustees and officials of the bridge have a proper understanding of the serious responsibility which they are incurring in proposing to put a plan into operation for which there is no approach to a precedent, and yet for which they have not even sought, much less obtained, independent expert countenance. All such advice which they have obtained has been distinctly and emphatically against it. It may be that the plan will work more satisfactorily than seems probable *a priori*, but the additional chances for trouble, over the present system, are numerous and obvious. For example, all trains approach the station at full speed over very sharp reversed curves with a frog in the middle of them, instead of over a straight line. What may be the effect of a derailment of a loaded train at this point, still having hold of the cable, not to speak of the jerk to every train that passes over it? The same chances for derailment exist at each end of each platform. What will be the effect to start a panic of a collision of a derailed train with either end of either platform? A panic, if it does start, will be far more serious than now, from the fact that both platforms are entirely surrounded by tracks; and it is to be remembered that this plan, if as effective as claimed, will double the present enormous crowd, which rises to 14,000 per hour, and that it is not necessary to have a real cause for panic to start one in such a crowd. A blow, a drunken frolic, a pistol-shot, a man falling in a fit, a great multitude of trifling causes, may start it; and once started, no power can stop it till perhaps scores of people have been swept from the platform in front of an approaching train. Add to the chance of such wholly needless panics, those which may legitimately result from accidents to trains, switching engines and cable plant, and a strong chance of serious accidents is added to the certainty of an intolerable crowding in all the rush hours, which already has no parallel in the world, and which, after these plans have been carried out, will be far worse than now. For there can be no doubt whatever that a plan which does not even purport to do more than double the capacity, and which will really do far less than that, will not permanently relieve the crowding, any more than the addition of a fourth car to the trains has done. Rather, the new capacity will be immediately absorbed by a flow of new traffic, which is now driven away from the bridge to the ferries by the physical impossibility of getting across the bridge in decent comfort. The following little table of the growth of traffic over the bridge is eloquent on this point:

Average daily number of passengers for first nine months ending May 31, 1884	21,380
June, 1884 to June, 1885, inclusive	30,881
June, 1885 to June, 1886, inclusive	59,825
June, 1886 to June, 1887, inclusive	72,298
June, 1887 to June, 1888, inclusive	80,019
June, 1888 to June, 1889, inclusive	87,386
June, 1889 to December, 1889	93,993

The most urgent requirement of the situation, therefore, for the sake of safety as well as comfort, is to *reduce the crowding* by giving ample platform space and means of ingress and egress. This the adopted plan makes no real attempt to do, but rather aggravates and perpetuates the present situation in that respect. Were it unavoidable that there should be this crowding, it is an evil which would have to be borne. As it is admittedly and demonstrably not unavoidable, the responsibility is great of deliberately perpetrating it,—a responsibility which may be unpleasantly realized, too late, when its natural consequences appear in some horrible panic disaster.

The Report of the Interstate Commerce Commission.

The third annual report of the Interstate Commerce Commission, advance copies of which have just been sent out, is by all odds the most important and carefully prepared document which the Commission has issued. The experience which its members have gained has given them a comprehension of the knotty problems of railway administration, which was lacking, as regards most of the members, when they first assumed their duties; and their discussion and recommendations in the report before us will certainly carry much weight.

The following is a brief outline of the topics treated in the report: Under "Organization of Force and Distribution of Work," it is stated that besides the commissioners, 68 officials and clerks are engaged in the regular work, statistical, etc., of the Commission. Investigations and proceedings of the Commission are held generally at Washington, but during the past year about 38 formal and many informal hearings have been held at other places.

Amended rules of practice and forms have been adopted and are now in use. Three circulars have been issued during the year setting forth the amendments to the law and the necessity of posting of tariff schedules.

An investigation of the subject of free passes and free transportation was begun in May and is not yet concluded. The Interstate law has greatly reduced the amount of "dead-head" travel, but there is still a good deal which ought to be suppressed. Mileage, excursion, and commutation tickets are improperly handled at times and their use should be regulated by law. The investigation of the ticket commission evil disclosed the fact that millions of dollars are being paid out annually by the railways in commissions, a practice which has been condemned by the Commission in former reports.

Car mileage, free cartage and ticket brokerage have all been carefully investigated and many serious abuses have been found to exist. Legislation on all these matters is urgently needed.

A brief summary of the questions decided by the Commission and by the United States Courts is given and will be found valuable for reference.

Much improvement has been observed in the filing and publication of tariffs, and few complaints are now made that the law is not obeyed. During the year ending Dec. 1, 1888, over 180,000 tariffs were filed with the Commission. The records of the shipments of freight kept by railway companies has been made the subjects of a special report by Mr. C. C. McCAIN, Auditor of Rates and Transportation, to the Commission.

The total number of reports and other documents of the Commission distributed during the year was over 90,000.

The report of Prof. HENRY C. ADAMS, Statistician to the Commission, has been unavoidably delayed by the tardiness of some of the companies in making their returns. Much progress is being made toward greater uniformity and accuracy in the compilation and presentation of statistics.

Nearly eight pages are devoted to a resumé of the work done at the Conference of State Railroad Commissioners with the Interstate Commission held in Washington last March, and fully reported at the time in this journal.

The long-and-short-haul clause of the law, and its workings where enforced, have been carefully observed by the Commission. It is believed that the exceptions to the strict observance of this clause are rapidly growing less.

The tedious delay in expediting the adoption of uniform classification is condemned; and it is plainly stated that the reform must be expedited by the railway companies.

A half dozen pages are devoted to the discussion of the competition of Canadian railways with American lines, but as the subject is now under investigation by a Senate Committee, no recommendation is made.

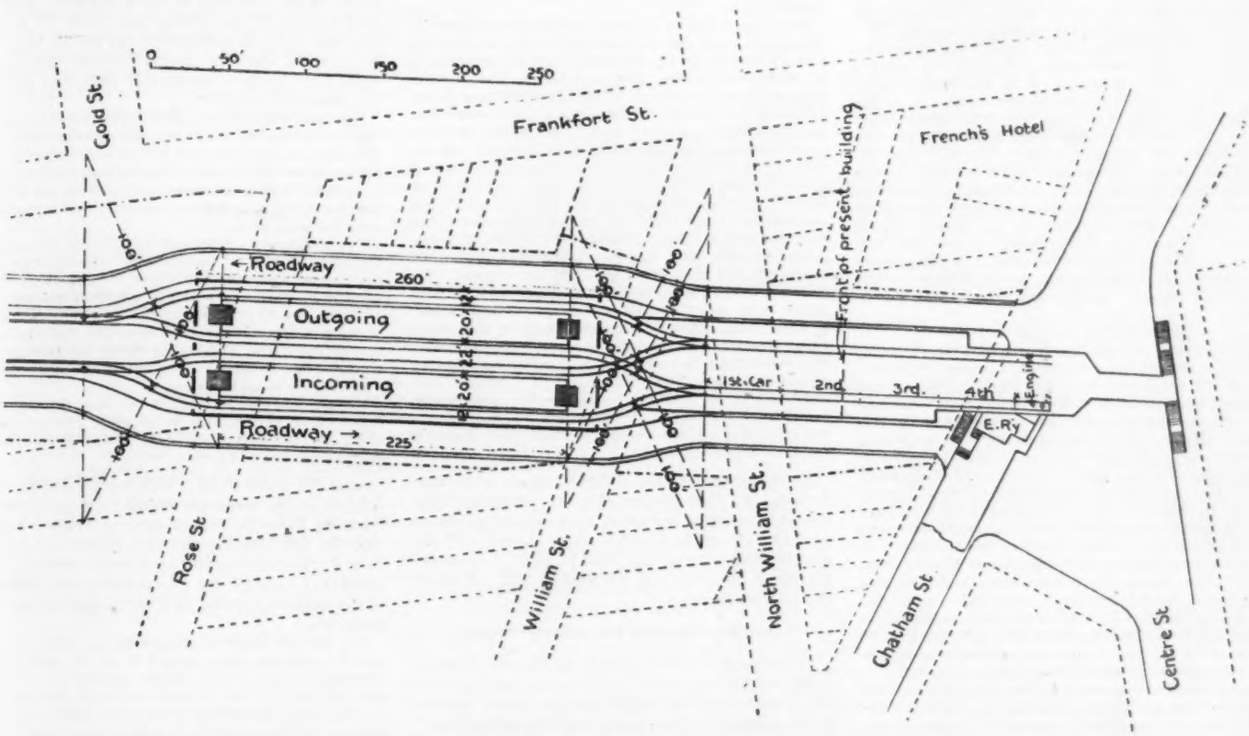
Export rates, the relations of lake and rail transportation, and rail transportation not subject to the law are carefully considered. It is explained how carriers by water and railways whose lines do not cross State boundaries seriously interfere with the proper and just enforcement of the law.

Consolidation of railway lines to form systems, and the interchange of traffic are fully considered and some important statistics are given.

Complaints against the workings of the law have emanated from those who formerly benefited by the discrimination and favoritism practised. The act has been administered in such a manner as to secure the coöperation rather than the enmity of the important interests involved. The Commission believes that, on the whole, good results have followed, and that the great body of the carriers of the country are desirous of coöperating in the enforcement of the law.

The important additional legislation recommended includes the prohibition of the payment of ticket commissions and the handling of tickets by scalpers, the regulation of car mileage payments, and an extension of the law to make it applicable to common carriers by water.

A fuller abstract of the discussions and statistics presented by the Commission regarding the above matters we shall give in a later issue. What seems by all odds the most important matter which the Commission takes up is, "Federal Regulation of Safety Appliances." No less than 17 pages, or nearly one-sixth of the entire report, is devoted to an exceedingly able discussion of this question, and we abstract it as fully as possible and comment upon it in our editorial columns.



Adopted Plan for New York Terminal of Brooklyn Bridge.

[Reproduced from our issue of April 28, 1888, since which date the changes are of detail only, not affecting the substance of the plan, which was adopted by the Board of Trustees, April 17, 1888.]

STATISTICS OF ACCIDENTS.

The following figures are taken from the annual reports of the railroads of the country made to the Commission for the year ending June 30, 1888:

Passengers killed	315
Passengers injured	2,138
Employés killed	4,970
Employés injured	20,148
Other persons killed	2,807
Other persons injured	3,602
Total persons killed	5,282
Total persons injured	25,888

But the reports do not cover the total mileage of the country; only 92,792 per cent. of it. If the accident rate was the same on the roads not reporting, the total number killed was 5,693 and the total injured 27,898. These are the returns made by the railroad companies themselves, and they cannot well be suspected of exaggeration. Neither is there, on the other hand, any reason to suppose that they are not, in most cases, complete and prepared with perfect good faith.

A thought strikingly suggested by these figures is that accidents to passengers take up an undue proportion of the public attention. Not only are casualties to employés several times more numerous, but they are concentrated upon a comparatively small class, each individual of whom undergoes considerable hazard.

Records of the Brotherhood of Railroad Brakemen show an average membership during 1888 of 10,052.5. Insurance was paid during the year on 114 deaths and 53 total disabilities, resulting from injuries while on duty. In the same time there were only 31 deaths and 6 total disabilities from natural causes. Thus one in every 88 of the members of this organization is killed yearly, and one in 60 suffers either death or total disability. It appears also that a brakeman has only 31 chances in 145 or 1 in 4.7 of being allowed to die a natural death.

No record is kept showing the number of lesser injuries received, but if the ratio of killed to wounded is taken as the same as that which, according to the figures quoted above, holds good in accidents to railroad employés over the country at large, namely, 1 to 9.73, the number of those receiving injuries serious enough to be reported to the Commission would be, exclusive of the killed, 1,109, or 1 in 9 of the members of the order. It would appear from this result that, besides running great danger of death, a brakeman will, on the average, be injured once for every nine years of service. It should be said that this brotherhood includes quite a number of conductors and others whose occupation is less dangerous than that of brakeman, so that the hazard to brakemen is presumably somewhat greater than here shown. It is probable that no occupation followed in this country by any large class surpasses in danger that of the railway brakemen.

INVESTIGATION OF SAFETY APPLIANCES.

Two circulars have been issued concerning the use of safety appliances. One dealt especially with automatic freight car couplers and was addressed to master car builders on the leading railroads, asking for technical opinion as well as for the facts. The other had to do with the general subject of

Federal regulation of the mechanical features of railroad working, and was sent to State railroad commissioners, heads of railway employés' organizations, railway experts and others.

AUTOMATIC FREIGHT CAR COUPLERS.

No satisfactory statistics exist of the number killed and injured in coupling cars. For the year ending June 30, 1888, 326 deaths and 6,827 injuries were reported to the Commission as due to this cause, but these numbers are somewhat less than the true ones, for the reason that part of the roads reporting keep no record which distinguishes coupling accidents from the total number. The danger of stepping in front of a moving car to guide a link into a pocket is sufficiently plain, and such a method of coupling has been considered for many years a reproach upon railroad construction. Nor is the danger of it the only objection to the link-and-pin system. It is both expensive and mechanically defective.

It is a mistake, however, to imagine that these difficulties are easily remedied or that there have been until very recently automatic devices against which serious or fatal objections could not be brought. Although some thousands of couplers have been patented, the difficulty has not been to choose among good ones, but to find any good one. Nor can any mechanic, however great his experience, judge by looking at a coupling device or by merely mechanical tests, what defect it may have. The conditions are so complex that only various and extended trials in actual service will determine the merits of a coupler, and many which gave the greatest promise have failed in such a trial. Nor is it possible, consistently with public safety or with railroad interests to neglect the non-mechanical consideration, most difficult of all to satisfy, namely, that automatic couplers to be successful must be of a uniform type throughout the country. In fact, it is the difficulty of obtaining this uniformity that now offers the most serious obstacles to the progress of automatic couplers and supports the demand of railway employés for some authoritative action.

ACTION BY STATE LEGISLATURES.

Although the deaths and mutilations occurring in coupling cars had been repeatedly discussed in the reports of State commissions, and railroads had been urged to move more vigorously towards adopting automatic couplers, the first legislative action was taken by Connecticut in 1882. The statute provided that automatic couplers, approved by the railroad commission, must be placed on all new cars, under a penalty. A statute nearly identical in its provisions was enacted by Massachusetts in 1884. In that year also the Legislature of New York passed a law that after July 1, 1885, no couplers other than automatic should be placed upon any new freight car to be built or purchased for use in the State. In 1885 a statute quite similar, naming the same date, July 1, 1886, was enacted in Michigan. Besides these of some years ago we have quite recently a New York statute, approved June 16, 1889, which provides that after Nov. 1, 1892, it shall be unlawful for railroads to run any of their own cars in that State unless equipped with automatic couplers.

It may be said of the earlier statutes that their greatest usefulness was probably in showing the railroad companies that public sentiment was earnest on the subject and required that something be accomplished. Uniformity was not furthered, since different commissions approved different couplers. The laws could not well be enforced upon roads only partly in the State. Many persons, including the present Connecticut commissioners, believe that the mixture of link couplings with a number of different automatic types tended to increase rather than diminish coupling accidents.

THE MASTER CAR BUILDERS' ASSOCIATION'S ACTION.

A description is given of the Master Car Builders' Association and a brief history of the steps by which the M. C. B. standard has been adopted. In 1884 a resolution was adopted that "the vertical plane type of coupler was mechanically the best." In September, 1885, a competitive test resulted in the selection of 12 couplers for further trial. In 1886 and the spring of 1887 tests of continuous freight brakes were made at Burlington, Ia., and these for the first time proved false what had long been claimed, that the "loose slack" of the link-and-pin coupling was necessary to enable a locomotive to start heavy trains. As a result of these tests, one of the types of vertical plane-hook couplers was recommended as the standard of the Association and was finally adopted by a letter ballot of 474 to 194. This "standard," it is carefully explained, does not grant a monopoly to any one manufacturer or patentee, there being now perhaps a dozen different patents under the standard type. The report continues:

The activity of railroads in fitting their cars with these couplers has not, however, been satisfactory or as great as was generally expected. The first cost of the standard couplers is considerable, from $20 to $25 a car, as against $10 to $15 for the link-and-pin form, and is alone sufficient to deter many roads from adopting them. The movement for their introduction, too, is actively opposed by all interested in patent couplers which they would supersede. Some look upon the action of the Association as premature and doubt its wisdom. Many are experimenting upon a small scale to determine which to choose of the patent couplers belonging to the type. The principal obstacle, however, is quite generally stated to be the need of uniform action. Automatic couplers serve no good purpose unless their use is so general that cars fitted with them come together in actual service. Obviously, then, there is a strong motive for each road to put off spending its money in making the change until assured of general operation.

The case may be summarized somewhat as follows: A few large roads have actually adopted some form of the Master Car Builders' coupler, and are bringing it into use as fast as could reasonably be expected. Many others are experimenting with various forms. A few, principally in New England, are actively opposed to the standard. A very large number mildly favor it, but are waiting for general action. The smaller, poorer, and less progressive roads are generally indifferent to the whole question.

Meanwhile coupling accidents are as numerous and distressing as ever, and the question is raised whether the action of the Master Car Builders should not be seconded by national legislation. That it should is the view that seems to prevail among the employés whose lives are endangered, and is held by many others. It derives support from what appears to be the impossibility of securing the necessary uniformity in any other way. On the other hand, there are grave objections to such radical action. Those railroads which are moving slowly in the matter may urge with plausibility that the question is comparatively new and one of great importance, and that not only pecuniary interests, but those of public safety also, will be, in the end, best served if they act cautiously and only after sufficient experiment. The standard was not finally settled and drawings of it published until April of 1888, and some particulars, not, however, essential, were determined only in the present year. However unfortunate the present condition may be it is not likely that any good will result from acting with undue haste. The requirements of a general law, which might be entirely reasonable for some roads, would work serious hardship to others, and probably result in forcing into use the cheapest and least desirable forms of the standard type.

As an instance of the difficulty in securing uniformity, the Commission cite the difficulty experienced in securing the use of such simple standards as the height of the drawbar above the rail and the position and size of the dead-blocks. A standard height of drawbars was adopted in 1872, yet diversity still continues.

CONTINUOUS BRAKES FOR FREIGHT TRAINS.

The control of freight trains by the use of automatic air brakes operated from the engine, says the Commission, "is looked upon as promising one of the greatest advances ever made in railroading." As a means of saving life, it is no less important than the use of automatic couplers, since (1) It diminishes the number of train accidents by collisions, etc., because of the celerity with which trains are stopped. (2) It decreases the damage and fatality by derailments by virtue of the automatic feature. (3) It does away for the most part with the necessity for traversing the tops of trains.

The returns to the Commission do not show the number of men killed and injured in falling from cars, but an estimate may be made by taking that proportion of the totals which is usually found to be due to this cause. Such a process gives: Killed, 613; injured, 4,025.

Besides preventing and mitigating accidents, continuous brakes make it possible to run heavier trains, a greater number of them, and at a higher rate of speed than would otherwise be safe.

The Burlington brake tests are then referred to, and it is said that the outcome of these experiments and of the improvements resulting from them has been a high degree of efficiency.

The obstacles to the introduction of the brake are much the same as those which hinder the coupler's use—first cost and the need of simultaneous action by many railroads. The question whether these delays are due to real inhumanity among railway officers is touched upon, and it is intimated that the fault is due to the financial officers rather than to the operating departments. The Commission has little sympathy with the view that accidents to employés are generally due to their own carelessness, as the report puts it:

There is no reason for supposing that trainmen value their lives less than other people or are less careful of them. A brakeman is as cautious as a general manager would be with the same duties, the same haste, exhaustion, and exposure.

HEATING OF PASSENGER CARS.

Public attention was not generally attracted to "the deadly car stove" until the three serious disasters at Rio, Republic, and White River in the winter of 1886-7, occurring in quick succession, concentrated public attention on the evil. In Massachusetts, New York, and Michigan laws were passed in 1887 aiming to make the use of stoves illegal after the following winter. Great activity on the part of inventors in originating and improving heating devices at once followed. Safety heaters were for the most part looked on with suspicion, and plans for heating by steam from the locomotive have received chief consideration.

The problem, though greatly advanced, is still in an experimental stage. The difficulties are enumerated, and it is stated that by all odds the most serious one is the question of uniformity in the steam hose couplings between the cars. There are now a dozen or more couplings upon the market, but the M. C. B. Committee, appointed in 1888 to recommend one as a standard, found difficulties so great that in their report this year they refuse to fix upon such standard.

Upon the whole, it appears that the more progressive railroad managers have shown energy in this matter and a sincere purpose to extend the use of continuous heating as fast as practicable. The present condition, however, is far from satisfactory, and towards the essential point of uniformity it is not apparent that any real progress has been made.

The problems of light and ventilation are naturally suggested by that of heating, but to cover, even in the most cursory manner, the whole subject of safety and comfort on railroads would be a tedious task and aside from the present purpose, which is to give such brief exposition of some of the more important matters as may help to show why Federal regulation has been thought desirable and perhaps to suggest something of the difficulties it would have to meet.

Mention may also be made of the block system and of interlocking, to encourage wider use of which would undoubtedly be a part of the duty of any Federal agency taking cognizance of such matters.

THE PROBLEM OF FEDERAL REGULATION.

After giving some quotations from the reports of Railroad Commissions of several States, showing that the difficulties in the way of State action in regard to the use of safety appliances for which uniformity is required are insuperable, the discussion of the general problem of Federal regulation is undertaken.

Two distinct ways of proceeding are naturally suggested. Congress may, should it see fit, pass definite statutes requiring that certain appliances be brought into use upon all the railroads of the country within a certain time; or, having in view the difficulty and importance of the question, it may prefer to make some provisions for its further investigation, trusting that the mere fact that such an investigation is in progress will not be without immediate results.

This Commission is not prepared to recommend a national law prescribing appliances. It does not assume to say that such legislation will never be advisable, but it is not prepared to say that it is advisable at present. The difficulties of formulating a law from which good results could be expected are certainly very great, if not insurmountable, and, although pains have been taken to secure the views of all interested, no legislation of this sort has been suggested that seems plainly to be wise and safe. A statute requiring that all freight cars be fitted with automatic couplers by a certain date—a requirement against which it is probable that less could be urged than against any other suggested—has already been shown to be open to serious objections. It is impossible to say what the result of such a law would be, but there is no certainty that they would be good. If it did not bring about uniformity—and there is no assurance that it would—it would be most injurious to all interests involved, including those of public safety.

While it is no doubt highly desirable that results be reached as soon as possible, it is still more desirable that no mistakes be made. Nothing could be more unfortunate than a repetition, on an enormous scale, of the unsatisfactory results of State legislation. If the State statutes of a few years ago regarding couplers had been national statutes, it seems plain that the question would be in less hopeful condition than it is at present. The effect of that legislation was to hasten the adoption of a variety of automatic couplers, most of which must of course be set aside if uniformity is to be attained. In fact, the strongest opposition to the Master Car Builders' type of coupler—the one that, so far as can be seen, has most chance of uniform adoption—is found in New England, where as a result of State legislation, automatic couplers not of that type have secured a strong hold.

reasonable prudence and regard for the lessons of previous experience require that action involving the compulsory use of particular appliances should be undertaken only with the greatest caution and upon more thorough investigation than has as yet been practicable. It has been suggested that for the present, at least, the interests of safety would be better served by providing for a board of specialists, so constituted as to command respect from both the railroads and the public, whose business it would be to make investigations and recommendations relating to railroad casualties.

To determine in detail precisely how such a board or bureau should be organized, just how much it should be expected to accomplish, and what powers should be given it, is a matter of much delicacy, in the study of which careful attention should be given to bodies of a similar sort now in existence.

The two organizations discussed are the United States Steamboat Inspection Service and the Railway Inspection Staff of the British Board of Trade. Of the latter body a lengthy account is given, and it is explained why its powers have been almost wholly advisory and why the many attempts to give it more absolute authority have not been successful. The Commission believes the reasons presented in England against the placing of administrative power in the hands of the Board of Trade to be conclusive here, as well, against the establishment of an agency with power to enforce the use of particular appliances.

The fact is not to be overlooked that in many States a very thorough system of inspection is already in force under the direction of the Railroad Commissions.

Twenty-six States have already provided for State commissions with powers and duties varying somewhat in degree but of the same general character. This tendency is in the direction of increased power and duties in these boards. Judging from their rapid growth in the past, both in numbers and scope, probably every State will soon have a commission upon which will be imposed, among other things, the duty of thorough annual inspection of the roads in each State, respectively, and of investigation of all matters pertaining to accidents and injuries in railroad operations. The necessity for Federal inspection and regulation will exist, as already shown, more especially where uniformity is required in safety appliances in the train equipment.

With these general statements the whole subject is submitted to the wisdom of Congress. It will be perfectly obvious, on what is stated, that if any system of Federal inspection or supervision in respect to railroad appliances is provided for, it must be impossible for the members of this Commission in person to perform the duties of such inspection and supervision.

Horatio Allen.

(With Portrait.)

HORATIO ALLEN, who in his 27th year ran the first locomotive which ever turned its wheels in America, and who was even then, and long afterwards, one of the most prominent civil engineers in America, was born in Schenectady, N. Y., almost with the century, in 1802. His father, the head of a large school at Hyde Park, on the Hudson, was an educated and well-to-do man, and gave to his son all the educational advantages of the day. He was graduated from Columbia College in 1823, standing high in mathematics, and immediately turned his attention to civil engineering. His first engagement was on the Chesapeake & Ohio Canal. Soon after he entered the service of the Delaware & Hudson Canal Co., still a great and important corporation, and then the greatest engineering enterprise of the day, JOHN B. JERVIS being its Chief Engineer, and Mr. ALLEN one of his most trusted assistants.

While in this position, STEPHENSON'S first locomotives were set at work on the Stockton & Darlington Railway, in 1825. Both ALLEN and JERVIS were watching these locomotives with keen interest, and both of them independently seem to have reached the conclusion that they were the coming motor, long before there was any absolute proof of that fact, or any general impression to that effect even in England. In fact there is no more honorable page in the history of American engineering than the quick way in which the capabilities of the locomotive and the railway were detected and developed on independent lines, even in advance of the corresponding English development.

In this development Mr. ALLEN took a leading and important part, second only to JOHN B. JERVIS and ROSS WINANS, if indeed even to them. Besides the Stockton & Darlington locomotive tests, before noted, the little Quincy, Mass., road and the Mauch Chunk Gravity road were opened in 1826-7, and Mr. ALLEN has recorded that his studies of the matter convinced him thus early that the locomotive and the railway were the coming means of transit, so much so that he resigned his position to go to England and look into the matter. In the meantime Mr. JERVIS and others of the company were drifting to the same opinion, and the result was that Mr. ALLEN was sent to Europe commissioned to buy three locomotives as well as rails for the company.

Mr. ALLEN sailed in January, 1828, and immediately on arrival met GEO. STEPHENSON, by whom he was most courteously treated. As a result of the then pending dispute as to whether tubular or flue boilers were best, he ordered but two locomotives from the Stephenson works, and one, which was to have flue boilers, of Foster, Rastrick & Co., of Stourbridge, a flue boiler, but as a matter of fact this engine also was built with a tubular boiler.

The three locomotives (the first ever ordered after the Stockton & Darlington successes) were received in New York in the winter of 1828-9, and at once set up and tested off their wheels. When navigation opened in the spring of 1829, one of these locomotives, which by accident was the "Stourbridge Lion" (of which we give an illustration,) instead of one of the Stephenson engines, was shipped to the head of canal navigation, at Honesdale, Pa. Had it been one of the Stephenson engines, the surprising results of the "Rocket" trials would very probably have been anticipated in this country, as they were perfect prototypes of the "Rocket," and one of them was the engine soon afterwards altered by JERVIS into the first of the now world-famed American type, by putting a leading truck under it.

Aug. 9, 1829, the trial came off. The line was straight for 600 ft., and then curved sharply across the creek, 750 ft. radius, over a trestle 30 ft. high, which was none of the strongest, and which was currently believed to be too weak to carry the engine. On this account Mr. ALLEN determined to run the engine alone, and mounting the foot-board, for the first and last time in his life, started off at full speed across the trestle, making a run of three miles and back into the woods. The engine proved too heavy for the track, and was consequently not set at work until the rapid progress of the art had made its type antiquated, so that it was never put into actual service; but this historic trip insures that both it and ALLEN will long be remembered. Fortunately this engine has been preserved, and was on exhibition at the Chicago Railway Exposition of 1884.

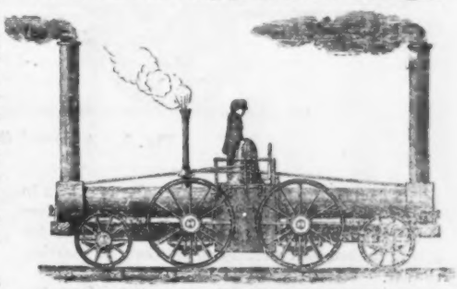
In the meantime Mr. ALLEN had been appointed Chief Engineer of the South Carolina Railroad, a line 150 miles in length, and on which the first continuous 100 miles of railway ever built was opened. This road was also the first of any length ever projected or built which was from the beginning intended to be operated by locomotive power. At this time (September, 1829) 16 miles only of the Baltimore & Ohio Railroad was opened and operated by horses. Oct. 6, 1829, came the "Rocket" trials

In the summer of 1830 came the trial of PETER COOPER'S little engine on the Baltimore & Ohio, an engine built the preceding year, and generally admitted to have been almost as sure a prophecy of the coming type of motor as the "Rocket." The same season the "Best Friend," the first American-built locomotive suitable for general service, was built by the West Point foundry for the South Carolina Railroad, from designs of Mr. E. L. MILLER. The next year (1831) the "West Point" was built at the same works for the same road from designs of Mr. ALLEN, and also a still more significant departure from past practice, the "South Carolina," the first 8-wheel engine ever built.

The Stourbridge Lion. The First Locomotive Run in America.

Built by Foster, Rastrick & Co., Stourbridge, England, 1828; operated at Honesdale, Pa., by HORATIO ALLEN. Aug. 9, 1829.

This engine, a cut of which we reproduce, was designed by Mr. ALLEN with the primary purpose of diminishing the load per wheel, which the rough tracks of that day made particularly necessary. On the South Carolina Railroad the track consisted merely of 6 x 12 in. yellow pine longitudinals capped by a 2½ x ¼ in. iron strap rail. To meet these conditions Mr. ALLEN invented what has since become better known as the Fairlie type. He placed two boilers, end to end, each supported on four wheels, a common firebox being in the centre. The engine



The South Carolina. The First Eight-Wheel or Double-Truck Locomotive.

Built at West Point Foundry in 1831 for the South Carolina Railroad, from designs of HORATIO ALLEN, Chief Engineer.

rendered fairly good service, but in the same year Mr. JERVIS introduced the locomotive truck, which almost at once became the standard for the continent. The "grasshopper" engines (one of them is still in use in the B. & O. yard at Baltimore) were introduced in 1832 by PHINEAS DAVIS and ROSS WINANS, but this was the last of vagaries in locomotive practice. By 1833 the present American types of both cars and locomotives were well defined; and Mr. ALLEN had helped not a little to define them, by informal discussions with JERVIS WINANS and others, as well as by his overt acts noted. The South Carolina Railroad, acting on Mr. ALLEN'S advice, was the first corporation in the world to formally adopt the locomotive as its motive power.

On the completion of the South Carolina Railroad Mr. ALLEN spent three years abroad. He then became connected with the Croton Aqueduct as Principal Assistant Engineer, under his old chief, Mr. JERVIS, having particular charge of the High Bridge and 42d St. reservoir in this city, on both of which works his name is inscribed. Completing these

works, he became one of the great engineering firm of Ward, Stillman & Co., afterwards Stillman, Allen & Co., whose great Novelty Iron Works at the foot of 12th St., New York, built most of the heavy engines for the early American steamships of the Collins line and Vanderbilt California lines, which in their day were far in advance of the Cunard and other English practice. Mr. ALLEN was also for a time President of the New York & Erie Railroad on its first formation, and afterwards, as Consulting Engineer, advised against the 6-ft. gauge in favor of 5 ft., which he had adopted for the South Carolina Railroad, and so fixed the Southern gauge. His advice was not taken, however, nor would it have made much difference if it had been. The gauge would still have had to be changed.

Mr. ALLEN was elected a member of the American Society of Civil Engineers on its resuscitation in 1867, and was its President from 1871 to 1873. He was elected Honorary Member in 1874. He was married in early life, and left a widow, son and three daughters surviving him. He died peacefully on New Year's morning, 1890, in the 88th year of his age, being the oldest civil engineer of note living in America, and the last survivor of the little knot of really great men who founded engineering as a profession in this country by the distinguished ability with which they attacked and solved the new canal, water-works and railway problems which the first half of the century brought all at once upon them.

A Novel Car-Starter.

A great many inventors have worked on the problem of a successful starter for street cars, as the records of the Patent Office show; but none of their devices have ever come into general use. The principle on which most of these machines work is to store up, by some arrangement of springs, the power expended in stopping the car, and use this to aid the horses in starting the car again in motion. It is a difficult matter, however, to store very much power in a spring, in proportion to its dead weight; and the expense, complication, weight, and uncertainty of these devices have operated to prevent their coming into practical use.

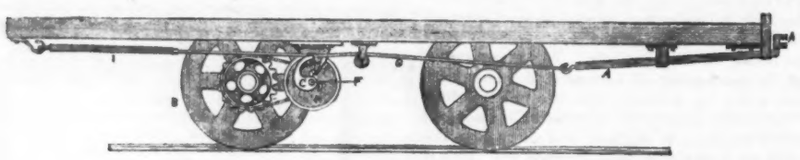


Fig. 1. A Novel Street-Car Starter.

The device of which a diagram view is shown in Fig. 1 operates on a different principle. It does not store up power at all, and is merely a device for giving the horses a leverage to aid them in starting the car.

The power of the horses is transmitted from the draw-bar A to the rear car wheels B through the involute curve wheel C and the sprocket wheels. The shaft F is caused to revolve when the draw bar A and its chain G are pulled out, by the operation of a clutch attached to the wheel C and moving with it, upon the friction wheel H secured to the shaft F. A spiral spring I serves to return the bar A and wheel C to their normal positions after each operation. It will be seen that as the greatest diameter of the involute curve is larger than the small sprocket wheel, power applied to turn round the wheel C is increased at the axle of the car. The leverage can be varied by changing the respective sizes of the sprocket wheels. The action of the starter, therefore, depends upon the power applied to the bar A to pull it out, and the multiplication of that power during its transmission to the car wheels, the horses moving at a greater speed than the car.

It will be noticed further that as the chain unwinds from the involute curve, the leverage of the horses' pull decreases until they pull directly upon the car without leverage. The full length to which the draw-bar may be extended is 15 ins. It will be seen, therefore, that the added leverage is principally of value in overcoming the axle friction at the moment of start. No claim is made that the device aids the team in overcoming the inertia of the car, to which is due the principal resistance in getting the car under way.

This machine has been in use, in an experimental way, for some time, and we are informed gives good satisfaction. There appears to be no reason why it should not work satisfactorily; the only question is, whether the gain by its use would be sufficient to make it worth while to equip cars with it. This could only be determined by actual trial, since the gain to be looked for is chiefly in the avoidance of the strains which are a frequent cause of the failure of street-car horses.

The inventor of the above device has also designed a starting gear for use with cars driven by electrical and other motors, which seems to have much more promise of value than the preceding machine, inasmuch as the leverage of the motor can continue for a considerable distance, long enough at least to enable considerable aid to be given in overcoming inertia as well as the axle friction at the start.

The operation of this device may be illustrated by Fig. 2. When the car stops, by a clutch mechanism the ordinary chain of gearing between the motor and the car axle is disconnected, and the power is made to pass through the drums G and G'. Through these, as may be easily seen, the motor may exert a considerably increased leverage at the start, which is gradually reduced as the speed increases, until the regular gear automatically comes into action.

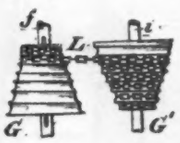


Fig. 2.

One great difficulty, thus far, with the problem of street car-propulsion has been the large size of the motor required to start the car under all conditions of load and grades. If this invention can be worked out in a practical mechanical way, so as to operate without too much complication, noise, or shock, and without introducing too much added weight, it may prove an important aid in solving the problem of producing a cheap and efficient street-car motor.

The device would be especially applicable to electric motors, now coming into such extended use for street-car service. A device which would enable further reductions to be made in the size and weight of these motors would seem to have much to commend it, from the economical point of view.

Further information concerning these two devices may be obtained of their inventor, Mr. JOHN H. PALMER, Drexel Building, Philadelphia, Pa.

The Paris Exposition.

Mr. H. TRUEMAN WOOD, in a late paper read before the English Society of Arts, gives some interesting notes on the Paris Exposition.

Mr. WOOD estimates that enough foreign gold has passed into France to more than offset the amount poured into the swamps of Panama. He figures that of the 6,000,000 or 7,000,000 people who came to Paris on account of the Exhibition, at least 1,500,000 were foreigners; and that at a moderate calculation of individual expenditure, about $250,000,000 was spent in the city of Paris, in return for the $3,500,000 appropriated by that municipality. This calculation does not include the money spent on the Exhibition itself, much of which came from foreign sources.

As to future advantage to be reaped by Frenchmen, the speaker enumerated the individual advantage to many traders of increasing a growing reputation or laying the foundation for a new one. France as a nation has shown the world the condition of her industrial resources, and made an impressive exhibit. She has also probably developed new markets, especially in the East and South America, and her industrial prestige has been greatly raised by the general results.

Mr. WOOD states the cost of the Exhibition and the method of raising the funds as follows. From calculations based on the experience of 1878, the cost was estimated at $8,600,000, and a possible income of $3,800,000 was allowed for. The deficit of $4,800,000 was covered by a State appropriation of $3,400,000 and a subsidy of $1,600,000 from the City of Paris. But instead of waiting for gate money, the administration raised at once a guarantee fund of $3,800,000 on the security of the receipts.

These guarantors were afterwards bought out by the Credit Foncier for the sum of $4,300,000, and to cover this the purchasers issued bonds to the extent of $6,500,000. These bonds were to be repaid (with the chance of drawing a money prize of considerable value) at periodical drawings, and the whole to be repaid in seventy years. In addition each bond, the value of which was $5, had 25 admission tickets attached to it; so that while raising this sum of money, they also issued 32,000,000 tickets. The scheme took amazingly; the money was subscribed seven times over and the bonds went to a small premium at once. The day after the opening, tickets nominally priced 1 franc, or 20 cts., were selling for 15 cts.; they soon sank to 10 cts. and even as low as 5 cts. The cheapness of the tickets had a distinctly unfavorable effect on the class of visitors; but they made the Exposition popular and in this respect serviceable to the country.

At the end it appears that the real expenditure was under $8,300,000. The credit side of the balance sheet has been approximately drawn up as follows:

Amount of guarantee	$4,300,000
Sale of privileges	400,000
Estimated sale of materials	200,000
State subsidy	3,400,000
Paris subsidy	1,600,000
Total	$9,900,000
Expenditures	8,300,000
Balance	$1,600,000

The total money spent upon the Exhibition, or its actual cost, cannot be estimated with even approximate accuracy. Mr. WOOD roughly estimates that the total actual cost to all nations and exhibitors was over $15,000,000.

The speaker noted as a feature of the Exhibition the great number of separate and comparatively small buildings; and he thought that as a rule all the buildings were better than their contents. The Paris Exhibition of 1889 was unfortunate in having few or no exhibits of commanding importance, and the prize of $20,000 offered by M. OSIRIS for the most important exhibit was awarded to the great Machinery Hall, which was no exhibit at all.

A German Substitute for Clearance Posts.

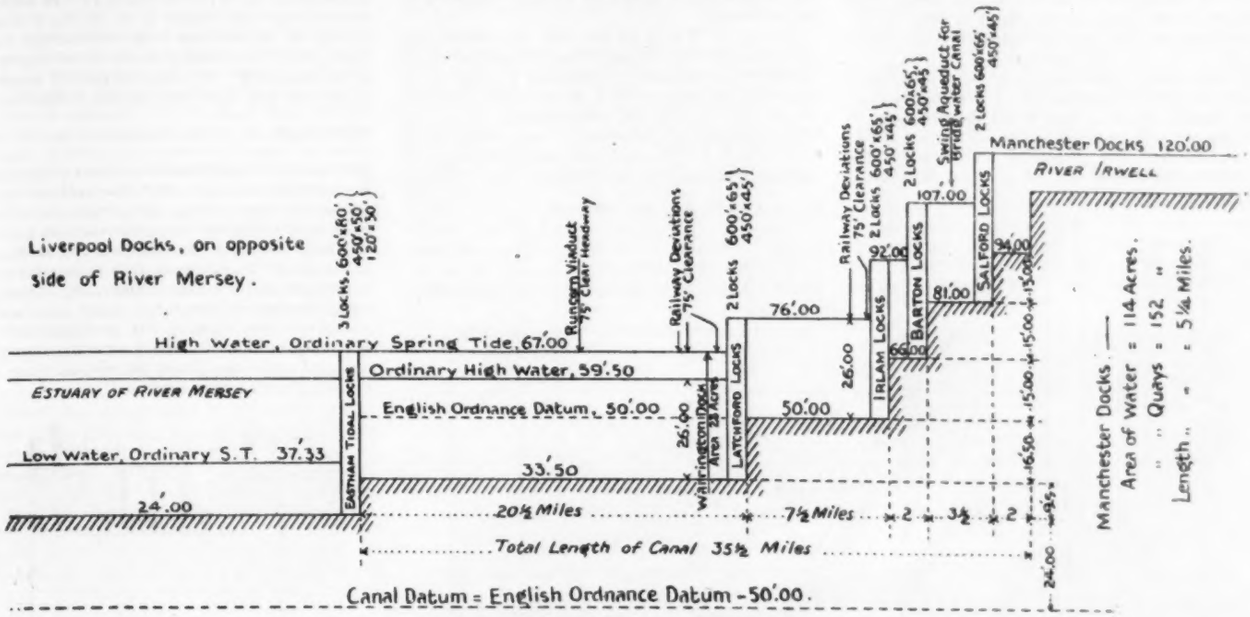
A new marker to serve as a clearance post, or to show the point beyond which cars must not be stationed on the tracks of a yard, is being placed upon the market by the Warsteiner Gruben & Hütten Works, of Warstein, Westphalia.

A German Clearance Post.

As may be seen from the figures, it consists of a hollow cast-iron body of a semicircular or semi-octagonal section, provided at the bottom with a foot a, which, with the nose b, is firmly pressed against the rail base by the bolt c and clamp d. Any injurious piercing of the web or special preparation of the rail is thus avoided without diminishing the firmness of the connection between marker and rail. The faces are enamelled in white and red, in either upright or horizontal bands, as the purchaser wishes.

In the manufacturer's circular the following statement is made of its value in winter: "Concerning its distinctness during snowstorms, experience has shown that upright bodies are always recognizable by their form when the snow falls quietly. If, on the contrary, the snow is driven by winds, then the smooth surface of our signal offers no lodgment to the particles."

The chief advantages claimed for this device are its durability, distinctness, low price, and safety as regards the employés in the yard. The cost of a single marker is 3 marks, about 75 cts. Something of this kind would seem to be more really convenient and durable than the usual post.



Condensed Profile, Manchester Ship Canal.

Condensed Profile, Manchester Ship Canal.

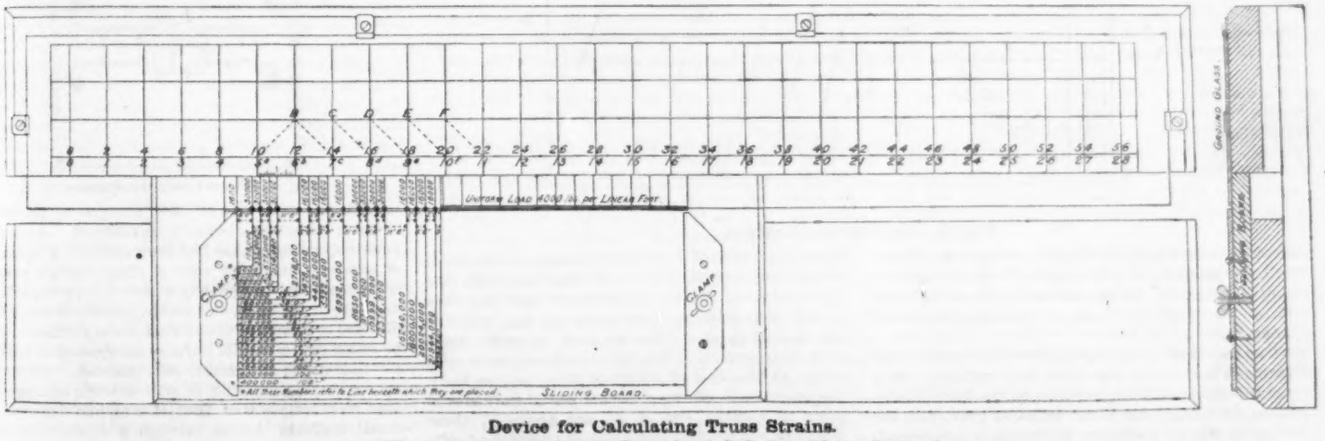
The accompanying profile shows in a nutshell the general form of this work as respects navigation, and especially the high and low water arrangements, which latter will make more clear a note on this subject which appeared in our issue of Dec. 14. Otherwise, the information shown in our cut merely repeats in more condensed form what has already appeared in various previous issues in relation to this interesting and important work, which is in our judgment destined to be the precursor of many other great ship canals.

Device to Facilitate Calculating Stresses in Trusses.

Prof. MALVERD A. HOWE, of the Rose Polytechnic Institute, Terre Haute, Ind., sends us the diagram herewith (reduced from a full-size drawing) of a contrivance for lessening the labor of calculating the stresses in bridge trusses when the method of engine diagrams is used.

It consists of a scale—preferably of cross-section paper—under a piece of ground glass, and a sliding board which carries the engine diagram. The problem is: given a certain truss and train load, to determine the stresses in the truss caused by the train load. The method is, on the ground glass sketch a skeleton of the truss to the same scale as the engine diagram; then place the engine diagram on the sliding board, and shift the same by the usual method to find the position giving the maximum moment or shear. The scale under the ground glass gives all lever arms at once, and the sliding board remains wherever it is placed.

The device may be useful to some of our subscribers, although our own opinion is that there is decidedly too much hair-splitting of these strains, which, after they are computed, are not only not the actual maximum strains (since they relate only to the static loads) but bear no close or certain relation to the actual strains, including effects of impact, oscillation, counterweights, lurching of engine, untrue wheels, etc., etc.


A C D E F
Uniform Load 4000 lb. per Linear Foot
Ground Glass
Sliding Board
All these Numbers refer to Line beneath which they are placed.

Device for Calculating Truss Strains.

[The moments engraved are for Pennsylvania R. R. Consolidation Engines.]

Clearing Water by Settlement; Observations and Theories.*

(Continued from page 609.)

Having reduced the problem to a system of settling basins to be operated on the plan of filling and drawing in rotation, it was desirable to reach as complete a knowledge as possible of the laws governing the clearing of water by settlement, especially to meet questions arising in regard to the economic design of the basins.

Some of these questions were: To what extent was there a clearing in the basins from the top down? as upon this feature would depend the economic depth. It was also thought that a small-scale experiment differs so much from a large reservoir, especially in the temperature and resulting currents, that conclusions based upon the one could not be relied on for the other case. The third question was whether covering the basins would effect a gain in rate of clearing commensurate with the added cost. The final query was, to what degree of clearness should the water be settled? as upon this degree the absolute dimensions of the system of basins must be based.

As far as the water-works engineer is concerned, the problem of simple settlement is confined to the consideration of a mixture of small particles of greater specific gravity than water and of different sizes, which at the commencement of settlement are about uniformly distributed through the water. These particles are gradually deposited; but that there must be some law or laws governing the rate of this deposit can hardly be questioned.

In this investigation an effort was first made to reduce the range in size of sediment that is found in the average water, and to observe, in the hope of suggestions, the settlement in its simpler form, with particles not greatly differing in size. This was done as follows: A gallon jar of muddy water was allowed to stand five minutes and the water then siphoned off down to the sediment that had settled, the jar filled up with filtered water, shaken, and allowed to again stand five minutes, the operation being repeated until the sediment left was of a kind that, when it was shaken up and allowed to stand, would leave the water very nearly clear at the end of five minutes. Having separated the

*Compiled by the author, JAMES A. SEDDON, C. E., from his "Report on the Treatment of the St. Louis Water Supply."

five-minute sediment from the finer grades, the rest was concentrated into a gallon jar and the ten-minute sediment taken out in the same manner; that is, the jar was now allowed to stand ten minutes, and the sediment settling in that time washed with filtered water until it was clear of finer grades. After this the 20-minute, 1-hour, 4-hour,and 24-hour grades were taken out in order.

These grades, examined under the microscope, showed a very fair graduation in order of size, much as a sample of river sand would show if sorted by sifting through sieves of increasing degrees of fineness. In fact, the generalization followed, that where the grades of the sand bar ended—that is, material rolled along the bottom or carried in intermittent suspension—the grades of the sediment, or material carried in permanent suspension, began forming an unbroken scale of increasing degrees of fineness.

The fact that a separation of the sediment could be made in this way was taken as a sufficient basis for the provisional theory that, in the main, settlement was simply due to the action of gravity on the range in size of sediment, producing a corresponding range in the velocity of subsidence, with which velocity the respective grades passed down. The repeated washings with filtered water necessary to clear the finer grades from a given class was considered due to the finer grades reaching the bottom with that class from respectively lower and lower levels.

It was reasoned, that if settlement followed this theory, there would necessarily be formed a curve of clearing from the top, the shape of the curve depending on the range and relative amount of the different grades in the water, and that this curve would pass down to the bottom through a definite phase. This curve could be clearly seen by the eye to pass down in the 5 and 10-minute classes, and while not so perceptible in the 20-minute and 1-hour classes, still during their settlement pipette samples taken from the top and bottom of the jar, when compared in test tubes, showed the top sample the clearer. It will be unnecessary to mention other experiments with the classified sediment.

The phenomena of settlement under this provisional theory may be discussed as follows. We may conclude that, as an average, the same thing is taking place in each vertical element, and so reduce the consideration to that of a single element of indefinite depth.

Taking $A\ B$ (Fig. 3) as such an element, and knowing that at the beginning of settlement the sediment is uniformly distributed through it, we may call the amount of it at any point, sediment density, or δ_1; thus the total sediment in $A\ B$ at the beginning of settlement is represented by the area $A\ B\ Y\ X$. We may now arbitrarily take the sediment making up δ as arranged from $A\ B$ in an

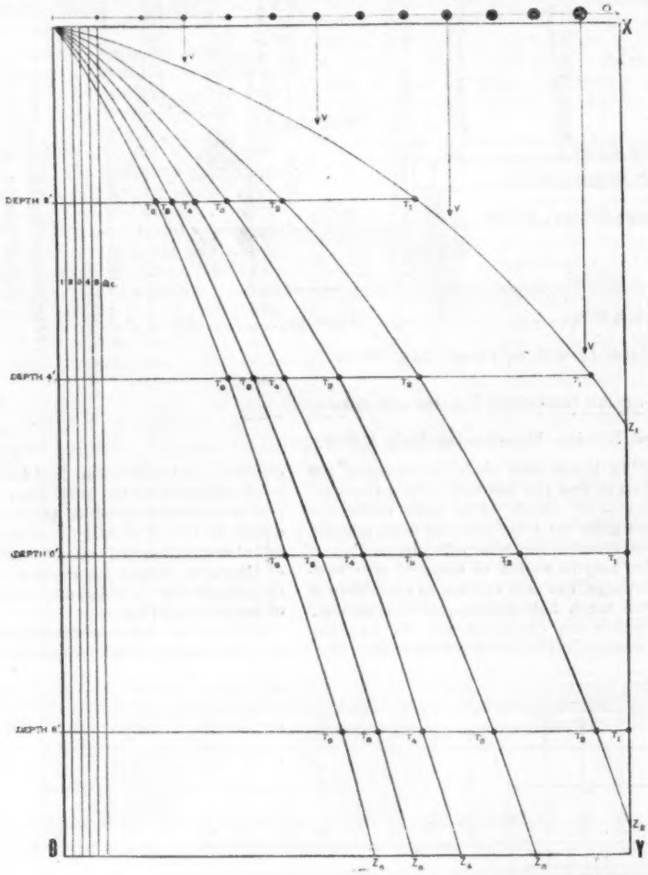


Fig. 3. Settlement Diagram.

increasing order of velocity of subsidence (approximately an increasing order of size) and with this representation the theory assumes that the area $A\ B\ Y\ X$ is made up of elements 1, 2, etc., which at the beginning of settlement start to move down with their respective velocities, as if they were solid strips; at the end of a unit of time, say one hour, the upper ends of the elements would have moved down to a curve, say $A\ Z_1$, and above Z_1 there would be respectively less and less amounts of sediment in the water as we approached the surface, the amount and grade being given at any depth by the ordinate of δ, at that depth, to the curve $A\ Z_1$. Or the amount of sediment $A\ X\ Z_1$ would have settled out of the water above Z_1, while at the same time an equal amount would have been deposited on the bottom. At the end of two hours the upper ends of the elements would have moved down to the curve $A\ Z_2$, where each value of δ is at just twice the depth that it was at $A\ Z_1$, and so on for further hours.

It may be noted here that if this were the phenomena of settlement, in contrasting a settling basin of one depth with one twice as deep, the basin of double depth, though costing much more to build, would settle no more water per day, as far as simple settlement was concerned; for though it would hold twice the amount of water, it would take twice the time to bring this water to the same average clearness.

In considering test observations: from the conclusion on this theory that the given elements making up the sediment density of the water move down as if they were solid strips, and that hence the same value of δ was to be found at a given depth in one nour, at twice the depth in two hours, etc. We see that the curve $A\ Z_1$, or the V, δ curve, should be determined from observations at any depth, for V would equal depth (d) divided by time of settlement (T). If, then, samples of water were taken at 2-ft. and 8-ft. depths, respectively, at stated times, $T_1\ T_2$ etc., when the values of $V = \frac{d}{T}$ were plotted to the observed values δ of the samples, the points from the 2-ft. and 8-ft. depths should give one and the same curve. This would show that the velocity of subsidence of a given value of δ down to 2-ft. depth was also the same velocity of that value of δ down to 8-ft. depth, or that settlement was in accordance with the above theory. If, on the other hand, the observations at 8-ft. depth gave a different curve from those at 2-ft. it would show that settlement was not in accord with this theory, and also give a measure of how far and in what direction the theory was in error.

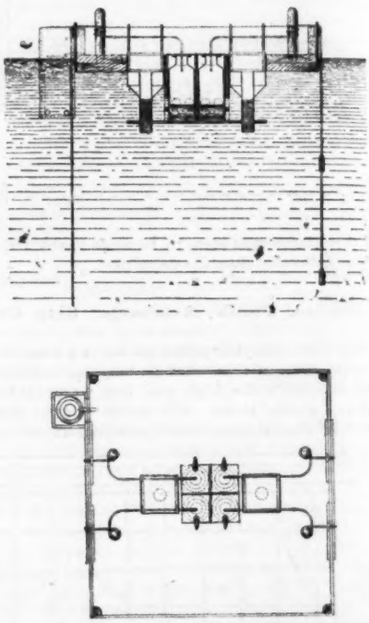


Fig. 4. Four-depth Integrator.

With the above test in view, a series of observations on the settling basins were planned. As some prior observations that had been made on a number of samples suggested that a single sample taken from one place in the basin was a very imperfect measure of the basin as a whole, attention was first directed to a method of securing a sample that could be relied on. For this purpose an apparatus called a "four-depth integrator" was planned. With the accompanying drawing it will be sufficient to say that its principle was that of a siphon drawing a small, uniform stream through a rubber tube adjusted to a given depth, and weighted to stay at that depth. The floats carrying the siphons were free from the float carrying the bottles receiving the samples, in order that the siphons might have a uniform head as the sample bottles were filled.

At the beginning of taking a series of samples the siphons were started in the side bottles and the float run out and back over a portion of its path, so as to clear the tubes of water in them, and get a distribution of water as it then was at the respective levels. The siphons were then changed to their respective bottles and the float moved slowly up and down the basin for taking the samples. The rubber tubes were respectively adjusted to 2, 4, 6, and 8 ft. depth, and the series gave a simultaneous integration of the basin on these four planes, or observations in the above vertical element $A\ B$, with the assurance that they represented the average element.

The series were given numbers in order of taking, and four samples of a series indicated by sub-numbers 1, 2, 3, 4, corresponding to 2, 4, 6, and 8 ft. depth

respectively. The average period of making an integration was twenty minutes, and the mean time was taken as the time of the samples; continuous observations on the velocity of the wind were also made from the time that the basin was filled through the period of taking samples.

The element δ, or density of sediment in the sample, was measured in two ways. First, a litre of the sample was filtered and the weight of sediment in it determined, giving sediment by weight in parts per 1,000 as a measure of δ. To make this determination with a precision sufficient to approximate the small differences in weight between two series of samples, or between the different samples of the same series, required a very careful investigation into the absorption of moisture by the filter papers, and a process of correcting for the difference of moisture at different times by the observed difference of moisture in standard papers. This cannot be considered here further than to state that in this way weight in parts per 1,000 was made a moderately fair measure of the small changes of sediment taking place. The subject in itself forms the material of a paper which has in part been presented to the St. Louis Academy of Science. Second, a measure of δ was made, called a "photo-comparator reading. The principle was that of the Bunsen photometer, the point of equal light being read, first, with the lights clear; second, with a given thickness of the water sample placed in front of the stronger light. The difference of the readings giving a measure of the light intercepted by the water sample, or the muddiness of the water. This, so far as I know, is a new and very delicate measure of sediment density and has the advantage of being rapidly made.

In the apparatus as finally constructed, two standard sperm candles were used simply to standardize the weaker light, and the stronger light was set from this to the zero of the scale. The readings of the observations were made with a preliminary apparatus, in which the two sperm candles were used in the place of the weaker light, and the scale was shorter. A complete discussion of this apparatus, with theory of length of scale, strength of lights, and probable error of the observation, would make the material for a separate paper.

After some preliminary experiment with the apparatus, complete observations were made three times on the settlement of a basin, Nov. 12-13, Nov. 14-15 and Nov. 16-17, all in a period of quite muddy and slowly clearing water. In each of these sets of observations series of integral samples were taken at intervals, designed to cover moderate changes in the clearing, through the period of settlement, and the element δ or density of sediment in the sample was measured, which, with continuous wind observations, formed the data of a set.

(TO BE CONTINUED.)

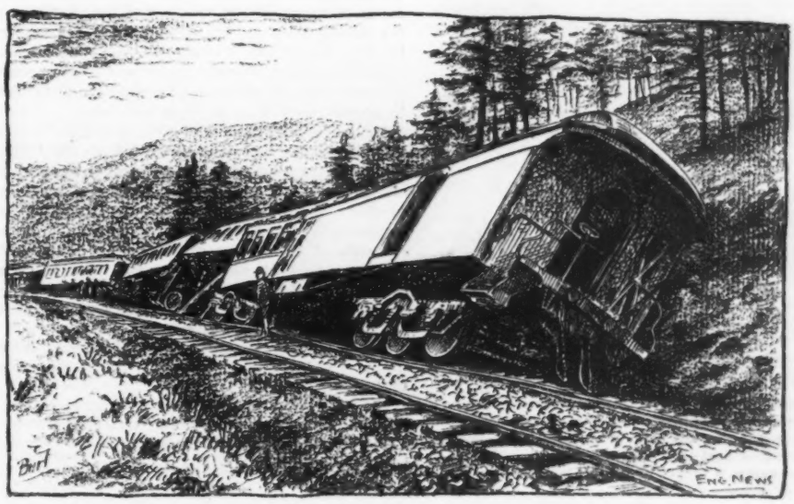
The White Sulphur Springs Disaster.

The fast "Flying Virginian" vestibule special on the Chesapeake & Ohio Railroad was wrecked 1½ miles west of White Sulphur Springs, West Va., Saturday, Dec. 28, at 7.20 A.M., as we noted last week. There were ten persons killed and thirteen injured. The train was drawn by a ten-wheel locomotive, and was composed of one mail and express car, one composite car [in the foreground of our view], one day coach, one dining car, and two Pullman sleepers.

From details which reach us from an authoritative source, we condense the following account:

The train was running probably forty miles an hour at least, at the time of the accident. The engineer claims that he was only running thirty-two miles an hour, and was not using steam, but another engineer, a passenger on the train, claimed they were running sixty miles an hour. The accident was caused by a broken rail. The break occurred near the end of the curve, about 10 ins. from the joint. As the train went over, the flange of the wheel carried the outer rail, for about 75 feet, along with it, that is, tore it loose from the ties, without much shifting of the inside rail or the ties. The track was ballasted well, but the condition of the ties was such that they allowed the rail to pull clear out sideways, without moving the ties or the other (inside) rail.

The accident happened just as the train was leaving the curve, at the beginning of a light cut, about 8 ft. in center. The first coach to leave the rail was the composite car, which was followed by all the others except the rear Pullman, which did not leave the track. In the view you can see the outer rail is curved far out under the wrecked cars while the inner is not disturbed much. The first coach [not shown] was the express car, which, together with the rear tender trucks, ran along the ties for 60 ft. after breaking loose from the composite car in the foreground of our view. The engine did not leave the track: only the rear truck wheels of the tender were off. After the composite car jumped, it ran along the ties for 150 ft., when it plunged into the clay bank at the left, and the smoking compartment was completely telescoped by the following day coach, as is seen in the view, which is taken looking east, or against the direction in which the train was moving. Part of the day coach is shown over on its side against the bank, with its forward trucks jammed up among the rear trucks. Where



The White Sulphur Springs Accident, Chesapeake & Ohio Railway.

the tie prop is shown, is a great hole torn in the flooring by the trucks. The dining car is further back, and lies on its side. The first Pullman sleeper is only partly over, while the rear Pullman is all on the track. The position of the broken rail is at about the middle of the first Pullman. The rail is 58 lbs. per yard. Along the track is seen some new 76 lb. per yd. rail, which was laid up to about a mile east of the accident. There were 8 passengers in the smoking compartment of the composite car of whom 5 were killed, 2 escaped unhurt, and 1 (the conductor) was injured. The others were killed in the smoking compartment of the day coach and all of the injured were wounded in that car. No Pullman passengers were hurt.

The engineer says, it took about 45 seconds and all was over. It looks as though he had the train well under control. Of course, the express breaking away from the others, gave him better opportunity to stop in a short distance. The curve where the rail broke was a light one to the right. Could not find out the degree, and there was a tangent of about 200 ft., then [in the foreground of the view] a little sharper curve to the left.

Not 600 ft. farther west is a very high wooden trestle, which would have been a dangerous place indeed for the train to have jumped the track or struck a broken rail. Really, this fact should be regarded as conveying the most significant lesson of all of the disaster, for there can be no reasonable doubt that, had the train happened to jump along the ties for a few hundred feet, this disaster, bad enough at best, would have been frightfully aggravated. As it is, all the lives were lost by the telescoping so clearly shown in our cut.

THE BUFFALO GRADE CROSSING PROJECT moves slowly. The New York Central R. R. is ready to go ahead with its work; but the Erie, Lackawanna, Buffalo Creek, and Western New York & Pennsylvania railways do not seem to be in a hurry, says City Engineer MANN.

Aluminum and the Grabau Process.

From a lengthy article in a late issue of *Engineering* the following interesting items on the history and commercial progress of aluminum are abstracted:—

After unsuccessful experiments by DAVY, in 1801, and OERSTEDT, in 1806, WOEHLER succeeded, in 1827, in isolating aluminum by heating the chloride with potassium in a crucible. But it was not until 1854 that SAINTE CLAIRE DEVILLE really rediscovered the art of reduction and produced the metal in any commercial quantity. Since then the art has been perfected by many hands.

As to the price of this metal, in 1873 the United States imported 2 lbs. of aluminum valued at $22, or $11 per pound; in 1884, it imported 590 lbs. valued at $14.26 per pound. In 1885 Col. FRISMUTH commenced the manufacture of aluminum in the United States by volatilizing, in separate vessels, sodium from soda and carbon, and aluminum chloride from aluminum salts and chlorine gas; and in the same year the United States produced 3,400 oz. troy of the metal, valued at $2,550. The aluminum cap of the Washington Monument, which was made about this time, has a height of 10 ins. and a base 6 in. sq., and weighs 8½ lbs. Going back to the day of DEVILLE, this maker reduced the price, in the first few years of manufacture, from 1,000 frs. to 300 frs. per kilogram, or from about $90 to $28 per pound. Only a few years ago the price was still $10 per pound.

The remainder of the article in *Engineering* is devoted to a description of the GRABAU process of reduction. Mr. GRABAU starts with sulphate of aluminum, fluorspar, and common salt, as raw materials, with cryolite only needed for the reactions, but this is a bye-product of the process. The price of his aluminum will depend upon the cost of manufacturing the sodium; but the inventor hopes to furnish this at about 12 cts. per pound, and assuming a daily output of about 400 lbs. of aluminum, he expects to be able to sell the metal at about $1.25 per pound. This is now looked upon as a little too sanguine an estimate. The process of manufacture is thus described by our contemporary —

The process comprises three stages—the formation of aluminum fluoride, the manufacture of sodium, and the reduction of aluminum from the aluminum fluoride. Powdered fluorspar is mixed with a solution of from 10 to 13 per cent. strength of sulphate of aluminum in water, three parts of the former being reckoned for one part of Al_2O_3. The mixture is stirred and digested at 60° Cent. (140° Fahr.) for several hours. The spar soon swells considerably, and exchanges part of its fluorine against sulphuric acid of the aluminum salt, the resulting products being sulphate of lime and a new fluoraluminum sulphate having the formula $Al_2Fl_3SO_4$, which Mr. GRABAU calls fluorsulphate. By repeating this treatment, the reaction may be pushed to a liberation of 66 per cent. of the sulphuric acid. Nothing is, however, gained by carrying the reaction to its practica limit, and the digestion is interrupted when 55 per cent. of the sulphuric acid has been exchanged, which can easily be attained. After several [illegible] the fai

clear liquid is syphoned off and the gypsum sediment pressed out and washed, the waters serving afterwards for the solution of fresh portions of alum. The sediment retains about 3 per cent. of the alumina. The liquid syphoned off is turbid with basic alumina compounds, and also with silicic acid; it may further contain iron, both from the alum, though the latter can be obtained free of iron, and from the fluorspar. In any case, the iron may be removed by precipitation with prussiate of potash. The filtered liquid then consists of the fluoro-sulphate and of sulphate of aluminum, with smaller quantities of sulphate of soda and of gypsum, which is slightly soluble in water. This liquid is evaporated over a water bath to a syrupy consistency, and then intimately mixed with finely powdered cryolite, the proportions being such that the sulphuric acid combined with alumina may suffice for the sodium of the cryolite, which is a double fluoride of aluminum and sodium, $Al_2 Fl_6$, 6 NaFl. The semi-fluid mixture is dried in lead pans at 150° Cent. (302° Fahr.), and the now porous mass formed into pieces of the size of walnuts, which are then heated to incipient fritting. This heating should take place in boat-shaped cast-iron vessels with a lining free from iron and silicic acid, iron and silicon being eagerly absorbed by aluminum. The smelting must not be carried too far, or else the subsequent lixiviation would be impaired, and the sulphate of soda would not be properly separated from the aluminum fluoride formed. The two phases of the first stage, the formation of this aluminum fluoride, have thus been completed; about 55 per cent. of the applied sulphate of aluminum has been directly transformed into the fluoride by mixing fluorspar with the solution, and the remaining 45 per cent. by heating with cryolite. The mass to be lixiviated is more or less reddish or purely white; the extraction of the great bulk of sulphate of sodium offers no difficulty, but the last traces of the sulphate are as usual persistent, and require stirring of the lye and frequent decanting. About 15 per cent. of the aluminum fluoride also passes into solution under this treatment, with the greater part of any iron still contained in the salt cake. The insoluble residue forms the commercial aluminum fluoride for the reduction of the metal; it is dried, pressed, and shaped into pebbles of walnut size.

The second stage, the manufacture of sodium, has unfortunately not yet passed through the Patent Office, so that we cannot offer any particular about this probably most interesting part of the new process. We are assured that the generation hinges upon the continuous decomposition of common salt under application of chlorine gas, and that the price of sodium will be 1 mark per kilogramme, or about 6d. per pound. So far as we are aware, sodium cannot at present be obtained in England at less than 4s. a pound. The sodium serves immediately without any further preparation for the reduction of aluminum, the third stage.

The reduction is effected in crucible as wide as high, lined with a coating of cryolite 1 in. or more in thickness. This is best done by forming bricks out of cryolite powder moistened with salt solution. Pebbles of aluminum fluoride are heated in these vessels, which are carefully closed, up to about 600° or 700° Cent., under which the fluoride does not melt, and evaporates but little. A quantity of liquid sodium sufficient to reduce half of the aluminum is then admitted; the reaction begins almost instantaneously, and is completed within a few seconds. The cryolite melts; and the cold crucible, on being broken, shows a regulus of aluminum fused into the cryolite lining, which is supposed to prevent any contamination of the metal with the material of the crucible. If the fluoride has been made from natural cryolite, which always contains quartz, the slag is gray or black with finely divided silicon.

A few words about the special features of the Grabau process. The process as described is a continuous one, since the cryolite slags gained from the last reduction again serve for preparing fresh aluminum fluoride, without necessitating the addition of new natural cryolite. This is possible because the fluorine needed for replacing the sulphuric acid of the alum is taken from the fluorspar and not from the cryolite. The reactions may be explained by the following two equations, the first one showing the formation of the aluminum fluoride, stage one, and the second one the reduction of the aluminum, stage three, by means of the sodium obtained in stage two.

$$Al_2(SO_4)_3 + 6\,Na\,Fl, Al_2 Fl_6 = 2\,Al_2 Fl_6 + 3\,Na_2 SO_4. \quad (1)$$

$$Al_2 Fl_6 + 6\,Na = Al + 6\,Na\,Fl, Al_2 Fl_6 \quad (2)$$

Thus, theoretically, Equation 2 yields as much artificial cryolite as Equation 1 requires for the generation of the aluminum fluoride. Since, however, losses are unavoidable, the cryolite yield of Equation 2 could not suffice, if the fluorspar did not supplement the need. We have above pointed out that part of the sulphate of aluminum, from which we start, is directly transformed into aluminum fluoride by treatment with fluorspar; the remainder requires heating with cryolite for the purpose. If we only assume that the former reaction occurs to 50 per cent., the following equations, 3 and 4, would tend to prove that we have a surplus of 33 per cent. of artificial cryolite at disposal, amply sufficient to cover any losses during the various operations.

$$\left.\begin{matrix} Al_2(SO_4)_3 \\ Al_2 Fl_6 \end{matrix}\right\} + 6\,Na\,Fl_1, Al_2 Fl_6 = 3\,Al_2 Fl_6 + 3\,Na_2 SO_4 \quad (3)$$

$$3\,Al_2 Fl_6 + 9\,Na = 3\,Al + \tfrac{3}{2}(6\,Na\,Fl, Al_2 Fl_6) \quad (4)$$

As now the above decomposition of alum sulphate by means of fluorspar can easily be carried to 55 per cent., no addition of natural cryolite will become necessary.

Professor KRAUT, of the Technical College of Hanover, has examined the process, and reports very favorably. During the tests which he conducted at the experimental works, 83 per cent. of the theoretical yield was gained; the metal contained 99.62 per cent. aluminum, 0.23 iron, and 0.15 silicon. The aluminum was distinguished by remarkable brightness and durability.

United States Patent Office Business in 1809.

The Chief Engineer of the Maine Central Railroad, Mr. WM. A. ALLEN, sends us the letter given below, as showing the day of small things in the United States Patent Office. The applicant for the patent was the grandfather of Mr. ALLEN, and the letters were lately found among his papers. Dr. WM. THORNTON, who was the first United States Commissioner of Patents, was a man of wide scientific attainments and an active associate of ROBERT FULTON in pushing steamboat interests.

As contrasting then and now, it might be mentioned that the last patent issued from the United States Patent Office bears a number somewhere above 409,000; and even this gives no indication of the real number issued, as a new series was commenced some twenty-five years ago. The present rate of issue approximates 20,000 patents per annum. Several assistants could "write themselves blind" in attending to the clerical duties of the present staff. The letter referred to and its endorsements read as follows:

Patent for a pendulum scale to weigh gold, proof spirit, etc., invented by MOSES L. MORSE, Cambridge Port, Mass.

DEPARTMENT OF STATE,
PATENT OFFICE, Nov. 27, 1809.

SIR.—I have examined your papers and find them correctly prepared for a patent; but the specification is so long, that without assistance I cannot issue the patents as fast as they are demanded; and I fear that yours, with several others which are also very lengthy, will oblige me to defer them a little while; for the assistant I had wrote himself blind, and I have since been without aid. The drawing does Mr. PENNIMAN great honor.

Respectfully, etc.
WILLIAM THORNTON.

Mr. MOSES L. MORSE.

Received Nov. 27, 1809, from MOSES L. MORSE, of Massachusetts, thirty dollars in conformity with an Act of Congress, dated Feb. 21, 1793, entitled "An Act to Promote the Progress of the Useful Arts," for which I have signed duplicate receipts this day.

H. T. TUCKER,
$30. *Treasurer United States.*

PERSONAL.

An electrical engineer is to be appointed for the city of Cincinnati, O., at a salary of $2,500 per annum.

Mr. CHARLES WOOD, Assistant Engineer of the Cincinnati, Hamilton & Dayton R. R., has been appointed Chief Engineer, vice Mr. JOSEPH RAMSEY, resigned.

Mr. JOHN HORNBY, formerly of the Chicago & Alton R. R., has been elected President of the Fort Worth & Rio Grande Ry., vice Mr. B. B. PADDOCK, resigned.

Mr. JAMES T. GARDINER has been appointed General Manager of the Cincinnati, Saginaw & Mackinaw R. R.

Mr. CHARLES HAYWARD, of Bangor, Me., at one time a director of the Bangor & Piscataquis R. R., died Dec. 24.

Mr. CHARLES G. WICKER, of Chicago, formerly President of the Dakota Southern R. R., died recently at Tallahassee, Fla.

Mr. A. L. RIVES, General Superintendent of the Panama R. R., was injured in a collision on that road, Jan. 2.

Mr. W. H. KILLEN, of Appleton, Wis., has been appointed Chief of the Right of Way Department of the Milwaukee, Lake Shore & Western Ry.

Mr. WILLIAM VOORHIS, who amassed a large fortune as a builder of docks in New York and Brooklyn, died at Nyack on Jan. 4 aged 71 years.

Mr. JOHN FRANCIS O'ROURKE, M. Am. Soc. C. E., and late Engineer in Charge of the Poughkeepsie Bridge, was married in Poughkeepsie, N. Y., on Jan. 7, to Miss KATHERINE B. INNIS.

Mr. ARTHUR G. WELLS, Assistant to the President of the Ohio & Mississippi Ry., has been appointed General Superintendent of the Ohio, Indiana & Western Ry.

Mr. JOSEPH HASKILL, formerly of Savannah, has been appointed purchasing agent of the Georgia Central R. R. Mr. HASKILL succeeds Mr. WILLIAM H. PRICE, resigned.

Mr. G. M. CUMMING, General Manager of the Mountain Division of the Union Pacific Ry., has resigned. He was formerly Assistant Land Commissioner for the Northern Pacific.

Mr. FRANK HARRINGTON, formerly agent at Troy, N. Y., has been appointed Assistant Superintendent of the Mohawk & Hudson Division of the New York Central R. R.

Mr. SAMUEL M. GRAY was unanimously re-elected City Engineer of Providence, R. I., on Monday last without opposition.

Mr. JOHN B. DAVIS has resigned the office of Assistant Superintendent of the Buffalo Division of the West Shore R. R. His successor is Mr. C. H. KETCHUM, formerly station agent at Buffalo.

Mr. G. M. FARLEY has resigned the position of Superintendent of the Western Division N. Y. & N. E. R. R. to accept the position as Assistant Engineer with the Pennsylvania Co. west of Pittsburg.

Mr. STEPHENS, Division Superintendent of the Chesapeake & Ohio Ry., has been made General Superintendent of the system. His office will be in Cincinnati. Mr. MCKEE, the assistant to Mr. STEPHENS, will be made Division Superintendent.

Mr. JOHN BOGART, Secretary of the Am. Soc. C.E., and State Engineer of New York, was offered the Street Cleaning Commissionership by Mayor GRANT last week. Mr. BOGART declined, owing to a press of other professional engagements.

Mr. A. ROBINSON, Second Vice-President of the Atchison, Topeka & Santa Fé R. R., will hereafter perform the duties of General Manager of the road. Third Vice-President Mr. J. E. GODDARD, who has acted in that capacity, has been placed in charge of the traffic of the entire system.

Mr. JOSEPH G. FOX, A. M., Professor of Topographical Engineering at Lafayette College, died suddenly at Easton, Pa., Dec. 26. He had held the position since 1872. He was engineer of the Sixth Brigade, Second Division, New York State Guard, on Gen. HAMILTON'S staff, in 1863-64. Prof. FOX was in his 57th year.

Mr. W. O. HAMILTON, Auditor and Car Accountant of the Union Ry. Co., Indianapolis, has resigned from ill health. Mr. C. A. VINNEDGE, private secretary to Superintendent WHITCOMB, will succeed him, and Mr. GEORGE ESPEY will take the position of private secretary to Mr. WHITCOMB.

Mr. R. A. COWAN, Assistant Superintendent of the Madison Division of the Chicago & Northwestern Ry., has been appointed Superintendent, vice Mr. G. F. BIDWELL, who has been appointed General Superintendent of the Milwaukee, Lake Shore & Western Ry.

Mr. E. SHERMAN GOULD, Consulting Engineer to the Scranton Gas & Water Co. left on Jan. 4, for Havana, Cuba, in the interest of Messrs. Runkle, Smith & Co., to whom the contract for the water supply of the City of Havana has been awarded. Mr. GOULD expects to return Jan. 17.

Mr. HENRY R. PIERSON died at Albany, N. Y., Jan. 1. He practised as a lawyer, but retired from the practice of his profession in 1860, when he assumed the presidency of the Brooklyn City R. R. Co. In 1869 he went to Chicago to become the financial agent of the Chicago & Northwestern R. R., and during the two years he remained he was Vice-President of the company. He was elected Resident Director of the New York Central Railroad in 1871, and removed to Albany, where he has since resided.

Mr. JOSEPH RAMSEY, Jr., Chief Engineer of the Cincinnati, Hamilton & Dayton R. R., has been appointed assistant to Mr. INGALLS, President of the Cleveland, Cincinnati, Chicago & St. Louis. Mr. RAMSEY began railway life with the Pennsylvania in 1869 as assistant to M. J. BECKER, Chief Engineer of the P., C. & St. L.; 1870 to 1871 he was with the C. & M. V., as assistant C. C. WAITE; 1871 to 1879, was with the Pennsylvania Railroad, and Chief Engineer and Superintendent of the Bell's Gap railroad; 1879 to 1880 he was General Superintendent of the P., N. & L. E. railway, now Pittsburg & Western; 1880 to 1883 he was General Manager of the P., C. & Y. R. and Chartiers Block-Coal Co., and from 1883 to 1889 Chief Engineer of the Cincinnati, Hamilton & Dayton.

Mr. JOHN MCARTHUR, Jr., the architect of the new public buildings of Philadelphia, died at his home on Jan. 8, of heart failure. Mr. MCARTHUR was born in Wigtonshire, Scotland, May 23, 1823, and came to Philadelphia when 10 years of age. He served his regular term of apprenticeship as a carpenter; but during this time also studied drawing and architecture, and soon became known as a skilful architect. In 1848 he received the first prize for the plans of the new House of Refuge and was put in charge of its erection. Since then his name has

been connected with the design and erection of many notable buildings, chiefly in Philadelphia. During the civil war he was architect for the War Department. His chief monument, however, will be the public buildings of Philadelphia, upon which he has been engaged for 18 years, and upon which so far nearly $14,000,000 have been expended.

Mr. SAMUEL KEEFER, President of the Canadian Society of Civil Engineers, and otherwise well known to the profession, died at Brockville, Ont., Jan. 7. His most noted single work was the highway suspension bridge just below Niagara Falls. This was opened Jan. 4, 1869, and its roadway blown away in 1888, nearly 20 years later, in a terrific wind storm. The cables and anchorages stood, however, and were used in renewing the bridge, while it was reasonably claimed by Mr. KEEFER that the cause of the blowing away of the roadway was its enlargement from a single to a double track a year or two before, which was done without consulting Mr. KEEFER. Mr. KEEFER was a half-brother of Mr. THOS. C. KEEFER, ex-President of the Am. Soc. C. E. and Can. Soc. C. E., and also eminent as an engineer. He was advanced in years, being in his 79th year, we believe, at the time of his death. He was Consulting Engineer for the Canadian Sault Ste. Marie Canal and in many ways had occupied a prominent position in Canadian engineering practice for a generation past.

Mr. C. A. BECK, Acting General Manager of the Illinois Central R. R., has been appointed General Manager, with headquarters at Chicago. Mr. A. W. SULLIVAN, Acting General Superintendent, has been appointed General Superintendent, with headquarters at Chicago. Mr. E. G. RUSSELL, Acting Superintendent of Lines in Illinois and Wisconsin, is appointed Superintendent of Northern Lines, with headquarters at Chicago, and with jurisdiction over the company's lines north of the Ohio River and east of the Mississippi River. The title of Mr. M. GILLEAS, Superintendent of Lines in Iowa, is changed to that of Superintendent of Western Lines, with headquarters at Dubuque, Ia., and with jurisdiction over the railways west of the Mississippi River, which are operated by or for account of the Dubuque & Sioux City R. R. Co. The lines south of the Ohio River will be designated as "Southern Lines" as heretofore, and Mr. J. G. MANN continues as Superintendent of Southern Lines with headquarters at New Orleans.

Year	Post-offices	Length of routes (miles)	Gross revenue	Total pay of postmasters	Millions of			Money-orders
					Stamps issued	Stamped envelopes and wrappers	Postal cards	
1874.....	34,300	270,000	$26,500,000	$ 5,800,000	682	136	91	$ 74,400,000
1880.....	43,000	344,000	33,300,000	7,700,000	876	207	275	100,300,000
1889.....	58,999	416,159	56,175,611	13,168,990	1,982	453	387	115,081,845

PUBLICATIONS RECEIVED.

—*Omaha Municipal Reports*, year ending Dec. 31, 1888. Published by Order of the Mayor and Council. 8vo. pp. 338.

This highly creditable volume of municipal reports contains those of the Comptroller, Treasurer, City Engineer, Board of Public Works, Supt. of Buildings, City Attorney, Fire Department, Chief of Police, Police Judge, City Physician, Boiler Inspector, Supt. of Plumbing, Sidewalk Inspector, License Inspector, Meat Inspector, City Veterinarian, Gas Inspector and Sewer Inspector; and they seem for the most part to be very practical reports by efficient city officers. The natural inference from the volume is that few cities are better governed than Omaha.

—*School of Mines Quarterly*, Columbia College, New York. November, 1889. 96 pp.

This number contains the following papers: "Incandescent Lamps," E. Z. BURNS: "Ash Determinations on Raw Sugars," F. G. WIECHMAN: "Maintenance of Track," T. J. BREKETON: "Modern Petrography," H. HENSOLDT: "Performance of Multiple-Expansion Marine and Pumping Engines," G. S. PERCIVAL; "Montana School of Mines," T. W. Traphagen; "Tests with the Blow Pips," A. J. MOSES; "The Silver Dollar equal to Gold," H. M. BENEDICT; "The Total Solar Eclipse of Dec. 22, 1889," J. K. REES.

— *A System for the Rapid and Accurate Computation of Quantities* for Roads, Railways, Canals and Other Works. By JOSEPH MEADOWS, B. A., C. E., M. Can. Soc. C. E., etc. Toronto, published by the author. New York: Campbell & Co. 8vo. pamphlet, pp. 15, 6 plates, 5 tables.

The system herein outlined, we fear, does not possess either the novelty or the utility that the author fancies. The practical instruction on this head in most English and some American treatises is rather blind, but if the author should study some of the best American treatises on the subject, he would change his views somewhat, we fancy.

—*Annual Report of the Postmaster General* for the fiscal year 1888-89. Pub. Doc. pp., 103.

A rather less than usually dry report, the most striking feature of which is the following table, on which we have already commented.

It is related that Postmaster-General BENJAMIN FRANKLIN was quite occupied and not a little troubled by the management of seventy-five post-offices. From the small beginning indicated in the early records the postal system has grown marvellously. In fifteen years its advancement has been even more astonishing, as the following figures are enough to show:

— *The New Omaha Bridge.* A report to CHARLES FRANCIS ADAMS, President of the Union Pacific Railway Company, by GEORGE S. MORISON, Chief Engineer of the Omaha Bridge.

A limited number of these reports are on sale with Mr. W. C. PRATT, 35 Wall St., New York, at $5 each. This report is uniform in size and style with the reports on the Bismarck and Blair Crossing Bridges. It includes 28 pages of text and 26 photo-lithographic plates.

— *The Cosmic Law of Thermal Repulsion.* An essay suggested by the Projection of a Comet's Tail. New York: John Wiley & Sons, 1889. Size, 7¼ × 5 ins., pp. 60.

This is an attempt to demonstrate that there is an essential difference between matter and force in the constitution of nature, and that "thermal repulsion and gravitational attraction" hold in position the very ground beneath our feet.

— *Transactions Arkansas Society of Engineers, Architects, and Surveyors.* Vol. II., 1888. Price, 50 cts.

—*History of the Boston Fire Department from 1630 to 1889:* By ARTHUR W. BRALEY. Boston: John P. Dale & Co., 8 vo., pp., 756.

This work gives all the laws concerning fires and their prevention during the period named—a record of all the larger conflagrations in that city. There are 83 full page plates of over 1,000 portraits of members of the present department, houses, apparatus, etc.

It is well printed and will be valuable among fire department officials as a book of reference.

—*Quarterly Report of Chief of Bureau of Statistics*, relative to Imports, Exports, Immigration, and Navigation of the United States, for three months ending June 30, 1889; with other Trade and Industrial Statistics, Pub. Doc, pp., 674.

—*Ferro-carril Trasandino del Norte*, EMPRESA G. PUELMA TUPPER, Buenos Aires.

—*Ferro-carril Interoceanico.* Leyes Concesionarias, etc. Empresa, Fco. Bustamente y Cia., Buenos Aires.

These two publications relate to two great transcontinental railway projects to connect Chili and the Argentine Republic, with maps and profiles.

TRADE PUBLICATIONS.

—*Calendar for* 1890. Pope Manufacturing Co., Boston, New York and Chicago.

This calendar is a curious illustration of the magnitude of the bicycling interest. It is in the form of a pad of 366 leaves, 5½ x 2¾ ins., one for each day of the year, and one for the entire year. A good portion of each leaf is blank for memoranda. The leaves are sewed at the end, enabling one to turn to any leaf desired, and by an ingenious device the leaves tear off independently, leaving no stub. The portable stand, which holds the pad, contains pen rack and pencil holder, and is made of solid wood, brass mounted. Upon each slip appear quotations pertaining chiefly to cycling.

—*Railway Safety Appliances.*—Mechanical Safety Appliances of the Parsons Block, Switch & Frog Co., 39 Broadway, New York. Illustrated; 30 pp., 9 x 5¾ ins.

The Parsons system is designed to prevent head and rear collisions and crossing accidents by a mechanical automatic block system of signalling and stopping trains approaching a point where there is danger of collision. The switches are operated by the engine driver. The system has been tried at the crossing of the Chicago, Rock Island & Pacific and Elgin, Joliet & Eastern railways.

—*Bituminous Sand Rock Paving.*—Pamphlet with description and testimonials, 26 pp. Union Pavement Co., 45 Broadway, New York.

—*Interior Electrical Conduits for the Wiring of Buildings.*—Catalogue and price list. Pamphlet, 19 pp. Interior Electrical Conduit Co., 154 W. 27th St., New York.

—*Calendar for* 1890.—Jackson Architectural Iron Works, New York.

A publication of great artistic merit, strikingly illustrating the progress of the country in these art manufactures.

SOCIETY PROCEEDINGS.

Connecticut Association of Civil Engineers and Surveyors.—The sixth annual meeting will be held January 14, at 10.30 A. M. at the office of C. H. BUNCE, City Engineer, Hartford, Conn. After the business meeting and dinner, the following papers and reports will be read and discussed:

A. R. WADSWORTH, "Farmington Water Works." F. FLOYD WELD: "Notes on the Care of Sewers." Report of the Special Committee on "Needed Legislation Concerning the Construction and Maintenance of Dams and Reservoirs."

Report of Committee on Railroads. *Question.*—What is the best method of heating passenger cars? Paper by W. E. PETTEE, on above question.

Report of Committee on Sewerage. *Question.*—How many cubic feet of water per second, flowing in a fresh water river, are necessary to dilute the sewage of each 1,000 people in average Connecticut cities, in order that the stream be inoffensive to the senses, and not injurious to the health of the people, the stream not being used as a water supply?

Report of Committee on Masonry. *Questions.*—1. What is the best method of determining the specific gravity of rubble masonry for the purpose of calculating the stability of a stone dam? 2. What is the proper coefficient for the friction of rubble masonry on itself, or how many pounds of horizontal pressure will move one hundred pounds of rubble masonry on a horizontal joint?

Report of Committee on Roads and Road Making. *Question.*—What are the merits of sheet asphalt as compared with granite blocks or crushed stone for paving northern, that is Connecticut, city streets?

Report of Committee on Water Works. *Question.*—Should applicants for extension of water mains be obliged to guarantee a certain percentage where the property is, or has been, paying water taxes? If so, why? And what is a reasonable percentage?

D. S. BRINSMADE,
E. P. AUGUR, *Secretaries*

Iowa Society of Civil Engineers and Surveyors.—The second annual meeting was held at Des Moines, Ia., Dec. 27 and 28, 1889. The President, E. M. GILCHRIST; Secretary, SETH DEAN; and Directors, M. R. LAIRD and CHAS. BENNETT were present; also a number of members and visitors. The Secretary's report showed a membership of 40, a small increase over last year.

President GILCHRIST delivered the annual address. A paper on "Street Pavements" was read by Mr. STEYH City Engineer, of Burlington, Ia., he recommended brick paving, as being cheap, durable, clean and free from noise. The main things to be considered are health, cleanliness, comfort and cost. He spoke of granite, macadam, asphalt, brick and wood, and reached the conclusion that brick paving is the most desirable. It has met with general approval. The city of Burlington has been doing some brick paving, though it took a good while to get the people in favor of it. They now have 50,000 sq. yds. of brick paving, and it will probably be doubled this year. The city also has a large amount of granite pavement but will lay no more, as the people are now in favor of brick and are anxious to have it extended. He gave tables prepared from tests made at the Rock Island arsenal, showing the strength of brick for paving. There is an opinion that brick will not stand heavy loads, but he maintained that it will stand the heaviest traffic. In reference to the digging up of the streets and thus making a poor foundation for any paving, he hoped to see the day when all water, sewer and gas pipes will be laid beneath the sidewalk.

An inspection of the plant of the electric line of the Des Moines St. Ry. Co. closed the first day of the meeting.

At the meeting of Dec. 28, the Executive Committee presented its report, recommending the incorporation of the Society and the establishment of a library. Mr. BENNETT, for the Committees on Legislation, reported that it had been impossible to do anything during the year, as there had been no session of the Legislature and recommended that a committee be instructed to prepare a bill to be presented to the Legislature this month; the report was adopted. Mr. R. G. BROWN, County Surveyor of Clinton County, read a paper on "Race Tracks," dealing with the mathematical and practical sides of the question. Mr. DEAN (Secretary) read a paper on "The Law of Accretion," showing that the law is not uniform among the different States. Mr. TSCHIRGI, City Engineer of Dubuque, read a paper on "Water Works for Small Towns." A visit was paid to the works of the Des Moines Tile Co.

The following officers were elected: President, E. M. GILCHRIST, Chief Engineer St. L. K. & N. W. R. R. Vice-President, M. TSCHIRGI, City Engineer, Dubuque, Ia. Secretary, SETH DEAN, County Surveyor, Glenwood, Ia. Treasurer, F. A. MACDONALD, Engineer, B. C. R. & N. R. R. Directors, M. R. LAIRD, Surveyor, Polk County; and CHAS. BENNETT, City Engineer, Des Moines, Ia.

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ASSOCIATE EDITORS.
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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Coming Technical Meetings.

Civil Engineers' Club, Cleveland, O.—Next meeting, Jan. 14. Secy., C. O. Palmer, 23 Cedar Ave.

American Society of Civil Engineers, New York.—Annual meeting, Jan. 15. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Next meeting, Jan. 15. Secy., W. H. Bryan, 809 So. 7th St.

New York Railway Club.—Next meeting, Jan. 16. Rooms at 113 Liberty St.

Civil Engineering Society (Mass. Inst. of Technology,) Boston, Mass.—Next meeting Jan. 16. Secy., Clement March.

Engineers' Club of Philadelphia, Pa.—Next meeting Jan. 18. Secy., Howard Murphy, 1122 Girard St.

Michigan Engineerng Society—Annual meeting at Detroit, Jan. 21, 22, 23. Secy., F. Hodgman, Olimax, Mich.

Western Railway Club, Chicago, Ill.—Next meeting Jan. 21. Rooms in the Phœnix Building.

Engineers' Society of Western Pennsylvania.—Next meeting, Jan. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

Ohio Society of Engineers.—Annual meeting at Columbus, O. Jan. 21 22 23.

Boston Society of Civil Engineers.—Next meeting, Jan. 22. Secy., S. E. Tinkham, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, Feb. 3. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society St. Paul, Minn.—Next meeting, Feb. 3. Secy., Geo. L. Wilson.

Western Society of Engineers, Chicago, Ill.—Next meeting Feb. 5. Secy., J. W. Weston, 270 La Salle St.

New England Railroad Club, Boston, Mass.—Next meeting, Feb. 12. Rooms in the United States Hotel.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting Feb. 12. Secy. J. C. Herring, Wichita.

THE letter by Mr. C. J. H. WOODBURY, Second Vice-President of the Boston Manufacturers' Mutual Fire Insurance Co., which appears in another column, puts in striking words the enormous difficulty of quenching fires, once well under way, by any other method than the old familiar one of flooding with a great volume of water. As such it will be particularly profitable reading for every one interested in fire protection. The hopelessness of attempts to rely on steam or carbonic acid gas, except in the very earliest stages of combustion, is very conclusively shown. That even the combustion of an ordinary floor, not to speak of what stands on the floor, should generate heat enough to evaporate water standing on it 2 ft. 7 ins. deep will be a new idea to most people, and yet when the calculation is followed, its truth is very readily seen. The letter furnishes as good a text as need be for an article on the essential folly of either using or permitting the use of wood for floors or main partitions in the construction of any of the buildings in the heart of the business districts of our larger cities. The hour cometh and now is, as we have often before suggested, when all of them must have a new kind of fire district, one being the old familiar kind of limit within which no wooden buildings are permitted; but the other, as yet unknown, a much more restricted area within which no wooden floors, roofs, or main partition work will be permitted. In New York this district should by all means include the entire city below the City Hall and a wide belt along Broadway and Fifth Avenue from the City Hall to Central Park; while no building over five stories high should be any longer allowed to be built in any part of the city except of the fireproof type. True economy demands it. Otherwise, it is only a question of time when New York will share the fate of Boston and Chicago.

THE American Society of Mechanical Engineers does two excellent things which other societies might well emulate. The first is to issue a list of members twice a year, thus keeping all addresses up to date. The second is to publish from time to time an "Employers' Bulletin," the nature of which can be best understood by the following extracts from the last Bulletin, all of them, we may note, being still *live* notices, which any one may answer who can offer positions of the kind sought:

The Secretary has the following memoranda as to members who will be glad to fill vacancies through the Society's channels:

No. 11.—26 years old. Grad. Mass. Inst. Tech., three years designer of pumping engines. Desires position which will secure practical experience for him.

No. 12.—M. E. Stevens Inst. Five years Member Am. Inst. Mining Eng., Eng. Iron and Steel Co., afterwards Inspector in Charge of Construction of blast furnace plant; experienced in design and construction of gravity inclines. Desires position where chance for promotion is good. Would prefer position with firm of engineers and contractors.

No. 13.—M. E. & E. E. in Europe; two years with blast furnace; one year in shop; three and half years draftsman in Europe on engine, boiler, centrifugal and electrical machinery; two years draftsman in America on heavy machinery. Seeks position as Assistant Superintendent or designer; 30 years of age and married.

No. 14.—M. E. Stevens Inst. Tech. Four years in shop and drawing-room; two years on R. R. Signal and Motive Power work.

No. 15.—30 years of age; ten years surveying, drawing and construction. Engineer of erection of oil-yard buildings and machinery. Prefers to take charge of construction, or to run a manufacturing plant.

No. 16.—Machinist and toolmaker by trade; has been foreman of tool room and shop, and chief engineer and M. M. of stationary plant. 36 years of age. Present salary $1,800. Seeks to be M. M. or Chief Engineer or Superintendent of manufacturing business.

How much good is accomplished by these lists we do not know; but if faithfully kept up, and some effort made to insure correctness of description, they ought to be productive of much good; and if only three or four engagements are secured yearly would well justify the trouble of issuing them.

GOV. HILL, in his late message, discusses the improvement of the country roads of this State, and decidedly favors a suggested system of main highways built and maintained by the State. As briefly outlined, this plan would propose two main highways in each county, running in different directions and intersecting each other, but connecting with the main roads of adjoining counties. This scheme would result in a complete network of well-made roads running into and through every county in the State; and these roads would be thoroughly well built by and at the expense of the State and be put under the control of the State Engineer during construction and operation, for the present at least.

The objection that the larger cities would thus pay, by taxation, for the bulk of the roads in the country districts, can be met by the statement that these roads are a public convenience and of vast importance to every member of the community, regardless of location. In summer, many of the city people would use these roads; and from a commercial standpoint, anything that improves the condition of the farming community and adds to their facilities for reaching a better market, eventually results in direct profit to the towns and cities where the money made is very generally expended. As Gov. HILL points out, this building of certain roads by the State is no new thing, for it was done extensively in our earlier history and up to at least 1831. The State now maintains free canals at an annual expense of over $1,000,000, and more than once in its history it has aided in railway building.

As Gov. HILL suggests that these State roads be thoroughly well built, macadamized roads, the amount of expenditure involved is necessarily great. If the Telford pavement be adopted, such as is now used about Plainfield, Orange, and other parts of New Jersey that are interested in constructing first-class modern roads, the cost would range from $8,000 to $10,000 per mile. The macadamized roads of the same State, four to six inches thick, are cheaper, but do not last quite so long, and cost more for maintenance; they range in price from $3,000 for large contracts, to $8,000 per mile. The very excellent macadamized streets in Plainfield, N. J., cost only about $3,000 per mile, and it is said that the repairs on 40 miles of these streets, last year, amounted to only $1,000. They required careful watching, however, and the immediate repair of any weak spot. These streets or roads in the township of Plainfield are 16 ft. wide, and they are built under the direct supervision of the supervisor and not by contract. The stone used costs about $1 to $1.25 per ton, and the usual thickness is only 4 ins. The 16 ft. wide Telford roads of Union Co., N. J., have 12 ins. of stone upon them, and the cost is about $8,000 per mile.

From this practical experience it may be assumed that roads of the macadam class described can be built for $3,000 per mile, or even less when the vast amount of work to be done on State roads is considered. This is a very reasonable figure and should give roads well adapted to the required purpose, provided that stringent methods be adopted for insuring honest work. It would doubtless take a number of years to perfect so extensive a system; and though the aggregate expenditure would be great, the resources of the State and the benefits of a thoroughly good road system are correspondingly great. For New York State at least the suggestion seems an excellent one; with the marked advantage of insuring roads of a practically uniform character in each county, which would serve as models of construction for the minor connecting roads which each county would doubtless soon build for itself. As the law proposed, however, would seem only to apply to the main-roads, supplementary enactment should follow to regulate, in con-

HORATIO ALLEN.

struction and general character, the minor roads, which are locally quite as important for the end in view as are the main lines of travel.

It is pretty well understood by this time that there is nothing slow about Washington; but that it is fast enough to have a P. D. Q. Railway would hardly have been expected, appropriate as it is that a railway should be P. D. Q. There is a P. D. Q. (& O.) R. R. already, however, the full name of the corporation being the Port Discovery, Quillayoute & Olympic R. R., as we noticed long since in our news columns, and a letter from the Chief Engineer, Mr. B. W. DeCourcy, informs us that its main purpose is "to develop and bring into connection with the outside world" a very interesting region, the Quillayoute Valley. The timber is the finest of the kind (fir, cedar, and hemlock.) There is also iron in plenty and semi-anthracite coal. Port Angeles is the natural port to the country and has a beautiful harbor. The road is intended to bring the products of the country for shipment in sea bottoms at Port Angeles. The harbor is about four miles long and about two wide, and is absolutely without a fault; it is egg-shaped or nearly an ellipse, the outer circumference being a very curious spit, a natural wharf, alongside which large vessels can moor and put out a gang-plank to the land. The lighthouse tender does so when supplying the lighthouse. The timber is wonderful, some trees furnishing 80,000 ft. B. M. to the tree, and 150 acres sometimes reaching 7,000,000 to 8,000,000 ft. B. M.

Washington is indeed a wonderful State, and beyond question has a great future before it, the worst thing about it being its name, which is going to cause endless confusion with the name of Washington City, besides being out of all harmony with the nomenclature of the other States.

The Nicaragua Canal people, realizing the great magnitude of their enterprise, are working very quietly and in a conservative manner, in notable contrast with the Panama proceedings, but effectively and really rapidly nevertheless. The contracts and sub-contracts, with detailed specifications, are being very carefully and thoroughly prepared. The Chief Engineer, Mr. Menocal, is in charge of the work in Nicaragua and making plans for its prosecution on a very large scale. The recent change of location of the Atlantic terminus of the canal is believed to have solved the problem of Greytown Harbor, which will be made one of the best on the coast, and the breakwater for its protection has already been begun. The borings from the big Divide Cut have arrived, as we have noted, and determine exactly the quality of the rock to be removed, which proves to be solid, the best condition to favor the work.

It looks now as though the entire work would be subdivided into three main divisions. The harbor of Greytown and the dredging up to the first lock will constitute the Atlantic or Eastern Division; the locks and Divide Cut, the great dam at Ochoa, and the rest of the work up to the lake, the Central Division; and the district from the Lake to the Pacific the Third Division. The contract for the Pacific Division will go to a strong California syndicate.

The company has a great many applications for all divisions and parts of the work from responsible parties. A strong English syndicate is desirous of taking the Divide Cut and the eastern locks. A dredging contract for the Eastern Division is practically closed and the dredges are being built. Within a year, we feel confident, the whole work will be in full operation.

The statistics of transportation for each year of the past decade, which it is proposed to gather for the next census on a blank which we lately noted, are largely a mere duplicate of Poor's statistics, and hence will not be of any great value to the railway public. In one respect, however, and in one only, they will be unique,—in the statistics of "equipment and stations." Locomotives will be reported under the three heads of freight, passenger, and switching, a note stating that they are to be divided about as they are divided in service, regardless of occasional mixed use. A correct report of the relative number of engines in these three services will have much interest, and probably show a startling aggregate of switching engines.

Passenger cars are to be reported as ordinary passenger, sleeping, parlor, dining, baggage, postal and express cars; and freight cars as box, stock, flat, coal, tank, refrigerator, and other cars. The relative proportions of these classes of cars, and of changes therein, will be a very interesting matter of study, for which now no material exists.

A Canadian correspondent writes us in regard to culvert formulas:

> In your review of Prof. Baker's work on masonry, published Oct. 19, you state Talbot's formula as follows: Area of water-way in sq. ft. = c (acres drained) $^{\frac{3}{4}}$ whereas it should be stated thus: Area of water way-in sq. ft. = $c \sqrt[4]{(\text{acres drained})^3}$ in which c varies from $\frac{1}{6}$ to 1 according to the country. However, I cannot get either of these formulæ to give reasonable results. I have always found Myers' formula (area of water-way in sq. ft. = $c \sqrt{\text{acres drained}}$ in which c varies from 1 to 1.6 for ordinary country, to give satisfaction.

We find that the exponent ¾ was not made quite as evidently an exponent as it should have been, but otherwise see no difference in the two forms given for Talbot's formula. Myers' formula seems to be generally regarded as the most satisfactory of any, but as the constant used may vary anywhere from 1 to 4, it amounts after all to guessing at it. Mr. Myers' rule for the constant is 1.0 in comparatively flat country, 1.6 in hilly, compact ground, and as high as 4.0 in mountainous, rocky country. As a check on the adoption of too small a section, such a formula is valuable; but we should be loth to trust to that or any rule as a finality, if one's unaided judgment would indicate a larger culvert; besides which, the area drained is rarely known precisely, often not even approximately, and the cost of a survey to determine the area might far better be devoted to enlarging the area of the culvert.

Increasing the Traffic Capacity of the Manhattan Elevated Railway.

In our issue of Jan. 4, we showed the desirability from every point of view of increasing the capacity of the New York Elevated Railways, and pointed out the improbability that this could be accomplished in any way except by increasing the number of cars in each train, without at the same time increasing the weight of the locomotive in such a manner as to add to the present strains upon the structure. Under these conditions, let us examine the different methods of solving the problem.

We may classify the three types of motive power which are fitted for use on the Elevated as, (1) electric motors, (2) steam locomotives, and (3) cable traction.

There are two possible modes of supplying a motor suitable for the elevated roads with electricity, namely, by storage batteries and by wire from central stations. Each type is in fairly successful use for motors on street railways, but neither type has been used, not even experimentally, to draw any such load as a train of six or seven loaded elevated cars, and there is room for doubt as to their economy. Without expressing an opinion as to the relative merits of the two systems in practice of a totally different sort, it seems certain that on the elevated roads the direct distribution of the electricity by wires along the track would be the most economical system. There certainly should be less waste in transforming power to electricity, transmitting it through a wire and turning it into mechanical energy again, than when we add to this process the complication of a transformation into stored chemical energy, which the storage battery system effects. The wire for supplying electricity to the motors could be run alongside the rails in this case, since none but the company's employés are allowed on the track.

To secure the greatest advantage from the use of electric motors, however, we should not copy the practice, necessary with steam locomotives, of placing the motor at the head of the train. With the electric motor, especially where the current is supplied by a track circuit instead of by a storage battery, the power can be subdivided with little loss of economy or convenience. Instead of using a single motor at the head of the train, whose weight, to secure sufficient adhesion for drawing the cars behind, must be a considerable percentage of the total weight of the train, each car should be provided with its own independent motors; and the dead weight of the locomotive, to which is due nearly 20 per cent. of the total train resistance, will be no longer needed.

Viewed from this standpoint, it is plain that the electric motor may make possible a very great increase in the capacity of the elevated roads. Trains of a dozen cars, even, might be run, and that without straining the structure as much as do the present locomotives. It would of course be necessary to have the motors on the several cars so connected that they would all be under control of the engineer at the head of the train; and with electrical appliances, this does not seem a matter of great difficulty. It is indeed true that no one as yet has applied an electric motor to the propulsion of single cars of the size and capacity of those on the elevated railway. When this shall be effected, the step to the operation of long trains of cars, with their motors so connected as to be governed by a single mechanism, will be direct and easy.

It is not at all chimerical to look forward to the time when, especially on roads of heavy grades or frequent starts and stops, power will no longer be wasted in hauling the immense dead weight of a heavy locomotive, and the electric motor will be used simply from motives of economy. But for the elevated road, where traffic is being lost by the lack of capacity to handle it, the gain would be very much more, and the inducements for bringing an electrical service into use are proportionately large.

Great as is the promise of the electric motor, however, it is quite true that the application of it which we have outlined is something for which no precedent exists. While there seems to be no inherent difficulties in this application, there may be obstacles in the design of certain details which do not yet appear. Let us therefore consider what means, if any, are available for increasing the elevated roads' capacity by locomotive or cable traction.

With the present elevated locomotives, a large proportion of the weight is carried by

the tender truck. If without concentrating this weight we can place it all on driving wheels, we shall have adhesion enough to pull eight or nine cars. Of course the use of the mogul or consolidation type of locomotives on the elevated is out of the question, both on account of the strain on the elevated structure, due to the concentration of weight, and of the inability of the locomotive to round the sharp curves. But the problem might be solved by locomotives of the Fairlie type, which consist really of two four-driver locomotives with the boiler between them. The engine is a perfectly practicable one to build, and has been used successfully for steep grade work in Mexico, South America, and various of the English colonies. It is an expensive machine to build and maintain, of course, since it is practically two locomotives in one, and if either is out of order both go out of service. However, it would be one of the most direct and inexpensive means of solving the problem before us, and there are many minor reasons for commending it.

In many respects the problem we are discussing is similar to that of the operation of railways on steep grades, since the necessary quick start is the mechanical equivalent of a steep grade, and the various methods of increasing adhesion which are used on such roads may be suggested for use here. Taking the Abt system as the best of that class of railways in which a gear wheel on the locomotive engages with a rack rail, it would no doubt be feasible to draw trains of eight or more cars on the elevated by laying the Abt rack rail along the line and building locomotives to run upon it. But the system can not be regarded as practically feasible. The running speed would have to be reduced, sufficiently perhaps to neutralize the gain through the longer trains; and the noise from the rack rail would probably be such a nuisance that its use would be impossible in our city streets.

The class of devices of which the Fell system is a type, which act by gripping a center rail with the driving wheels, securing thus sufficient adhesion regardless of the weight of the engine, would probably be no more noisy than the present engines. The most feasible method of applying it in this case would seem to be by increasing the pressure of the present driving wheels upon the rail by bolting a central rail of I section to the ties and by means of wheels running on the under side of the top flanges securing a downward pull on the locomotive, without, however, increasing the strain on the elevated structure. There seems no reason to believe that such a device would not operate with perfect success mechanically. The amount of the downward pull could be regulated to a nicety by connecting the grip to a piston in a cylinder supplied with steam from the locomotive boiler. We do not understand that the additional pressure of the driving wheels upon the rail would be excessive, at least not on the 70-lb. rail now in use on most of the elevated track. The device would probably prove an additional safeguard against derailment, since there would be no inertia of a heavy mass to cause "nosing" and shaking, as would be the case with an addition of weight to the engines.

Taking all things into consideration, it seems probable that this system would be cheaper in first cost and cost of maintenance than the use of the Fairlie type of locomotive. The weakest point of this system would be apt to be the locomotive boiler. Whether it would be possible to generate sufficient steam to get up speed quickly, and pull up steep grades with trains of eight or nine cars without frequent failures, would have to be determined by experiment. As stopping to get up steam is scarcely admissible on the elevated, it will not do to work the boiler so nearly to its maximum power as can be safely done on an ordinary surface road.

As to the use of the cable system, a paragraph in an article on the transit problem in our issue of Aug. 10, 1889, written by an engineer of this city, is quite apropos:

> If practicable, cable-traction would seem to be the best motive power for rapid transit railways, because the trains would move at uniform speed up and down grade, and thus keep well spaced. Doubtless it might be worth while to figure a little on the possibilities—a cable running at the speed of 50 miles an hour, to move an endless succession of trains (each weighing some 300,000 lbs.) following one another at short intervals and stopping on one set of tracks three times in a mile and on the other once in two or three miles, all on a line with grades galore!

For the elevated road the conditions would not be quite so severe. The cable would run not more than 25 or 30 miles per hour. Seven-car trains fully loaded would weigh at most 300,000 lbs. They would stop more frequently than is proposed above, however; and under conditions likely to occur, several of these trains might be started at one time. Certainly no service so severe has ever been performed by the cable system. The only approach to it is on the Brooklyn Bridge, and here the results have been not perfectly satisfactory. Nevertheless, by the use of short cables and frequent power stations, the cable system might be adapted for use on the elevated roads. The points of greatest uncertainty would be the invention of a suitable grip, which would not wear the cable as badly as the commonly used grip does, and the terminal arrangements for handling trains with safety, promptness, and with no danger of blockades.

To design such a system of operation and make it work successfully would be an engineering achievement of great importance. The inherent point of weakness in the cable system is the fact that a failure of the boilers, engines, cable-driving machinery or cable, at once blocks the the whole system. This can only be avoided by a duplication of the system throughout, and the extra cost tends in some degree to counterbalance the economy in operation over the separate locomotive system.

It is well to note, however, that the expenses of the department of motive power under the present system form a large proportion (39.5 per cent.) of the total operating expenses. In 1888 these expenses were as follows:

Repairs of locomotives	$176,967
Wages of engineers and firemen	719,344
Fuel for locomotives	769,132
Oil and waste (total used)	91,286
Water supply " "	79,128
Expense, department of motive power, about	$1,835,857
Expenses per locomotive (291 owned)	6,309
Total operating expenses	4,658,190

There is considerable room, therefore, to gain in economy over the present system; and we understand the managers of the company are so well aware of this, that if assured of the successful working of the cable system, steps would be taken at once to put it in operation. We must conclude, then, that while on the one hand there seem to be no insuperable difficulties in the way of designing a cable system for the elevated roads, it would be an engineering feat for which no precedents exist, and one involving many points of difficulty. Certainly it should not be adopted until so thoroughly perfected that blockades, either on the road or at termini, would be no more likely to occur than under the present system.

There is still one system to be considered which is closely related to the one already discussed, and which seems to us to have more points in its favor on the whole than any system thus far considered. We refer to the use of a cable system in addition to the present locomotives. Such a mixed system would have none of the defects of the cable system operated alone.

Let us note that the present locomotives can haul five-car trains fully loaded without aid. With the aid of the cable, seven- or eight-car trains could be hauled more rapidly than five-car trains are hauled now, since much less time would be consumed in getting under way. The grip could be attached to the locomotive and operated automatically by steam pressure let on and off by the opening and closing of the throttle. Since the cable would be no longer the only reliance, and since the strain upon it would be but a fraction of what it is when the cable system alone is used, the cost of installation of the cable plant would be hardly more than one-fourth that of a cable system for use without locomotives. No duplication of plant is necessary or desirable; and the plant may be worked up to its full capacity, since a failure is of comparatively little moment. This, indeed, is the great point which commends the combined system: failure of either source of motive power leaves the other to go ahead alone without stopping traffic. The cable system need not be run at all during the night, or in fact at any time when four-car trains are ample for the traffic. The speed of the cable need not be more than fifteen or twenty miles per hour, since the locomotive alone could easily increase the speed of trains when once that speed is attained. The power stations might be placed as much as two or three miles apart, perhaps, without exceeding the admissible strain on the cable.

On the other hand, the failure of locomotives would not result in the blocking of traffic as now. Even a blizzard would not stop operations, if the cable pulleys and their bearings were properly designed.

The handling of trains at terminals, so difficult a problem with the cable system alone, would be a simple matter with the combined system.

Certainly as regards the public accommodation, there seems every reason to believe that this system would be superior to any other. From the point of view of the Manhattan Elevated corporation, it is true, the system would cause an increase in operating expenses, rather than a reduction, which is promised by the cable system used alone. But the latter system is more or less an experiment; and to secure the same certainty and safety of operation that the combined system offers, a permanent investment of no small magnitude must be made.

The furnishing of safe, decent, and comfortable accommodations on the elevated roads is a matter of vital importance to all residents and property owners of New York City. We have been led to the conclusion that the present disgracefully overcrowded state of the elevated cars is not, as is commonly supposed, "an evil which cannot be cured and must be endured," but one that can be remedied at a moderate expense, which will be far more than met by the increased travel that in this case is sure to follow improved facilities.

Neither is it true, as has been generally claimed, that an increase in capacity is not possible without either rebuilding the structure or experimenting with novel and untested devices, with whose operation engineers are not familiar.

We have little but praise to offer for the manner in which the operating department of the Manhatten Elevated is at present managed; and for keeping on the side of safety

even at the loss of traffic, much commendation is deserved. Neither can the financial managers of the company be blamed for being reluctant to make any large and permanent investments to improve their property when their future control of it is so uncertain.

But as we have already pointed out, while the endeavors to establish real rapid transit lines in this city deserve all success, the people of New York want decent accommodations for this generation, and are not borrowing trouble about the needs of the next. If the Elevated managers will do the best that is in their power to do at present, they need have little fear as to the future of their property; and the establishment of competitors to encroach upon their traffic will be deferred for many years.

The whole question in a nutshell is this: The present five-car locomotive system is known to be adequate. In abandoning it for any other system whatsoever, there is a certain element of risk and of transitional inconvenience at least. On the other hand, we know a pure cable system to handle two or three-car trains is perfectly practicable, and if using the present structures without interfering with the locomotive traffic would be enormously profitable, since the traffic only waits for the cars to run to fill them. Why not combine the two systems, and run seven or eight-car trains by the combined power of locomotives and cables? Does not such a system combine the maximum of public, corporate, and engineering advantages? Each motor would then help out the other, and either could be used alone if necessary, at somewhat slower speed, with or without temporary reduction of train length. In fact, the surplus power of the locomotives when in motion, now not used, would almost keep the cable in motion, so that the fixed motive power could be small. We are confident that such a system can readily be worked out, and would prove in service a most satisfactory arrangement for all concerned.

Railway Safety Appliances in the Interstate Commerce Commission's Report.

The Annual Report of the Interstate Commerce Commission, an abstract of which is given elsewhere in this issue, devotes, as has been expected, considerable space to the question of railway safety appliances, especially the use of automatic brakes and couplers on freight trains; but contrary to the expectations of many, the Commission has taken a neutral ground on the question of legislation regarding these appliances, and seems, on the whole, to rather discountenance such legislation at the present time.

Evidently the Commission does not take this position, as many do, because of ignorance of the evils for which a cure is sought. That they have carefully investigated the matter, is shown by their report. Nowhere have the facts concerning the annual slaughter and mutilation of trainmen been more clearly set forth than in this document; and some reference is even made to the fact that the link-and-pin coupler and the hand brake are as barbarous from an economical point of view as they are on the score of humanity.

Neither is the reason for the Commission's stand, we believe, to be found in the difficulties which they enumerate as likely to retard the progress of the reform, or even stop it altogether. It is true, indeed, that in this portion of their report the Commission has been led somewhat astray. Their circular, making inquiries as to the progress in the use of automatic couplers, was sent out nearly a year ago, and as the statistics in our issue of Dec. 21 plainly showed, and for the first time, the notable progress in the introduction of automatic couplers has been made within the past twelve months. It is a very short time ago, too, since the Westinghouse freight brake was considered an appliance merely for line cars and for the "long-haul" roads in the far West. Its rapid introduction on cars in general freight service, and its general acceptance by progressive managers as a proper appliance for a common freight car, are matters of very recent history.

Some other difficulties in the introduction of automatic brakes and couplers are referred to, but they are comparatively of little moment. The Commission rightly diagnoses the main cause of all past delay when it says:

> The capital invested before the movement becomes somewhat general must, in large part, lie idle. . . . Obviously, then, there is a strong motive for each road to put off spending its money until assured of general coöperation.

But by the statistics published in our issue of Dec. 21, it was shown that the M. C. B. type of coupler is being so widely and rapidly brought into use that its future and early supremacy is unquestionable. Practically the same may be said of the automatic freight brake. Therefore the great obstacle in the way of compulsory legislation which the Commission believed to exist (our statistics not having been published at the time their report was written) is no longer in the way. On the other hand, the need for legislation to secure uniformity is largely past. The great want was some governing power to decide what the automatic coupler should be. No road had authority over any other, of course, and the State Railway Commissions were powerless. The National Government seemed the only authority which could compel the uniform practice essential to the reform's success. But by the good sense and really patriotic work of the Master Car Builders' Association (a body whose influence is as great as its authority is small), the question of uniformity has been settled. The only need for national legislation on these matters now is, first, to expedite the reform; and second, to oblige the few delinquent corporations, which may either wholly neglect or inexcusably delay the reform, to "cease from the error of their ways."

But returning to the report: while the Commission's erroneous belief that the question of a uniform coupler and brake was still unsolved, and their distrust in their own ability to decide technical questions may each have had something to do in influencing them to a neutral attitude, their report indicates that it is rather on account of the principle involved than for any other reason that they doubt the wisdom of congressional action to further the reform. Certainly they may well hesitate before establishing the precedent that Congress may prescribe the machinery which railways may or may not use to promote the safety of travellers and employés. We have quite enough laws passed for the benefit of special interests now, and what would it be if a host of enthusiastic inventors were to set up their lobbies at Washington? The Commission points out that laws of this sort *may* be passed; but, "the difficulties of formulating a law from which good results could be expected are certainly very great, if not insurmountable."

Next the Commission discusses the possibility that the matter of safety appliances might be turned over to some board of experts. The United States Bureau of Steamboat Inspectors and the British Board of Trade are instanced as bodies already existent which might serve as a guide and precedent for the establishment of a Government bureau of railway safety appliances.

The inspecting staff of the British Board of Trade, according to the report, have only advisory powers, and although at many times during the past thirty years efforts have been made to give them authority to compel the adoption of safety appliances, they have uniformly failed.

The reasons for this failure are set forth as follows:

> To clothe a government department with unlimited powers to interfere in the interests of public safety, with the detailed working of traffic upon railways, must necessarily create a concurrent responsibility, and in whatever measure this responsibility be cast upon a government board, the responsibility now resting upon railway companies will be diminished.

This reasoning, the Commission thinks, "is conclusive against the institution of an administrative agency with power to enforce upon railroads the use of particular appliances."

Good logic and good law this undoubtedly is; but the recent changes in the legal powers of the Board of Trade's inspecting staff must have been brought to the Commission's attention too late for inclusion in the report before us; and these facts have an important bearing upon the question.

In spite of the fact that travel by rail in Great Britain is vastly safer than in this country, and notwithstanding the potent argument that the State cannot interfere without lessening the railway's responsibility, the demand that the Board of Trade should be given more than advisory powers has become too strong to be disregarded. Under the provisions of a recent enactment, the Board of Trade is now proceeding to compel the adoption of the block system, the continuous brake, and the interlocking of switch and signal levers on all the railways of the United Kingdom. To show how decided this action is we reprint in another column their late circular.

Now, as the Commission says, it is acknowledged in England, by both the railways and the public, that the Board of Trade inspectors, during the years they have held only advisory powers, have been of the greatest service in promoting the safety of railway travelers and employés. Experience has shown, however, that a certain proportion of the corporations are not to be influenced by anything less than the strong arm of the law; and it is the general belief that the statute, by which certain specific mandatory powers are conferred upon the Board, will result in general benefit.

It appears, then, that the difficulties in the way of Government interference in the matter of the two safety appliances at present most important are not by any means so great as the Commission supposed; and further that we have an English precedent for interference in matters much less important to safety, under the comparative conditions there and here.

Our space will not permit any discussion here of the general question of Government action on safety appliances. We have pointed out the curious manner in which a considerable portion of the grounds on which the Commission bases its argument against Government interference has been swept away, since this is necessary to a correct view of the situation. Consideration of the principles involved in such interference, and the legislation, if any, which would be advisable to expedite the introduction of automatic freight brakes and couplers, we must defer to a later issue, congratulating ourselves meanwhile on the fact that we are making good progress in regard to both of them without any

aid whatever from legislation—progress notably more rapid that has ever before occurred in any continental reform whatsoever, which we can recall. Perhaps in time we shall begin to shoot ahead in the same way in respect to block signalling, use of interlocking plant, ample city terminals, over or under crossings for highways, in regard to which our average practice is now lamentably backward, and improving but slowly.

CORRESPONDENCE.

The Long Truss Rail Joint.

CHICAGO, ILL., Jan. 6, 1890.

TO EDITOR OF ENGINEERING NEWS:—

SIR:—The rail joint support illustrated in your valuable paper, issue of Dec. 8, 1889, belongs to this company and we have about 10,000 in actual service, on seven roads.

We have read with great satisfaction your exhaustive review of the joint question, and fully agree with you in your statements and conclusions. As to your queries and suggestions regarding our device, they are so candid and fair, that there is no ground for discussion, and I feel confident that a few words of explanation will show you that we come very near meeting the requirements of a perfect support for rail joints, that is, perfect comparatively.

1. You ask, "Is the base plate stiff enough?" We answer, we do not depend entirely on the base plate for support, but supplement it with the strut, which engages the bottom of the base plate, under the union of the rail ends. If we depended on the base plate alone, it would of necessity be either so heavy that it would make the joint rigid, or so light that it would not resist permanent deflection, and this leads to:

2. Where you suggest the use of one U-bolt instead of two, and that running transversly instead of longitudinally under the rail. We answer that in order to support the base plate—as before explained—the two U-bolts or truss rods must run longitudinally; but further than that, they not only act as a truss to transfer the load from one rail end to the other, but owing to their circular form, and the distribution of the strain through the radial lines of the strut, there is a degree of flexibility which, properly adjusted to strength, will make the conditions between the joint ties the same, or approximately the same, as between the other ties under the rail; and you will see that by the construction we are practically unrestricted as to strength and flexibility.

3. The short angle bars, while aiding to line the rail (the channel in the base plate also helps in alignment) do really very much more. Through the base plate, truss rods, and the track bolts, they help to bind the whole together, and give lateral support. I am not entirely certain but that it will be better to have them engage the head of the rail, so that in case of any failure in the truss rods they will act as a support in connection with the base plate. We do not claim that we can take the bend out of the rail under all circumstances, but this much has been done.—In a joint where, under a load of 90,000 lbs., there was a permanent deflection of ⅛ in., the rail ends were brought to a level by simply screwing up the nuts on the truss rods. Both the base plate and the angle bars are cambered ⅛ in. The truss rod is ¾ in. in diameter, and straightening between the bottom of base plate and strut or between arms of strut is hardly perceptible. The total weight of metal in the fastening was 47 lbs. Of course there is a great power in the screw, but whether, as I said, we could take the bend out of the rail end, I do not know. From experiments I think that we could raise them within a reasonable limit.

One word as to creeping. You will notice, we punch our base plate for spiking, so that there is less chance for the spike to loosen or draw than if the plate was slotted. The truss rod rests against the ties. The angle plate is firmly bolted to the base plate by the truss rods, and the rail bolted to the angle plate. How can the rail *creep* without tearing up the whole track?

Our device has been in track since April, 1889. The reports, as far as we have been able to get them, are very satisfactory, showing by service test that our claims are apparently well founded.

If the future does as well as the past in demonstrating the ability of the device to "hold up the rail ends" we shall feel that a life spent in studying the joint question, and in the bringing out of the *truss rail joint*, as a final effort—in pursuance of which a life was sacrificed—will not have been in vain. Many of your readers will probably remember the circumstances under which Col. RICHARD LONG, who was the inventor of the "Samson Joint" as well as this, was killed in Pittsburg last April.

LONG'S TRUSS RAIL JOINT CO.
BY WM. S. BREWSTER, Pres.

The Rail Joint Question.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR:—In your issue of Dec. 28, 1889, you take up "The Rail Joint Question." Will you kindly allow me to differ slightly from you in one or two respects? For instance, with the Cloud joint, which forms a double angle splice bar, it is not only possible to give a support to the ends of the rails, which support shall be equal in strength to the same length of span in any part of the rail, but even to exceed it, even double it, if so required. With the Cloud joint there is virtually no limit to perpendicular strength; the form is there, and all that is necessary is to make the metal thick and deep enough for the strength required.

The reason why fish plates wear and crush down and deflect under the ends of rails, is because they have not the strength of the rail for the same length of span, and because their upper bearing surfaces against the head of the rail are so small that the weight and blows of passing trains first crush, and then hammer the plates until they are low in the centre, and get worn into cavities with a permanent set. It is not hopeless to think that a perfect joint can be made by fish plates; for if the upper bearing surfaces are broad enough to resist crushing, and the depth of the plate is sufficient to give strength enough to uphold the ends of the rails, under the maximum strain, and the plates are kept to the rail by a sufficiently strong automatic power, there is no reason why wear or set should take place at all in the plates; and if this did not happen there appears to be no reason why the ends of the rails should drop and form a permanent set.

Your remarks A, B and C, I believe are true, but when you get on to joints such as those of the Fisher type, you appear to forget one of the most important elements in a perfect joint: perhaps I might say the most important. That is, keeping the heads of the rails in continuity, which that type of joint does not do. Thus, there is always a possibility and even probability that, in curves especially, the lateral pressure of the flange of the wheel against the head of the rail will bend the head of the loaded rail over, thus presenting the face or end of the receiving rail, for the wheel to strike and certainly jump, causing a derailment with certainly a loss of property and possibly life.

You try to cover the above objections by what you term correct spiking. No spiking on earth can hold the head of the rail true to half an inch. The spike simply holds the base of the rail so that the difficulty and objection and even danger of such joints still remain. They are not reasoned away in your arguments. I think Prof. DUDLEY has clearly demonstrated over and over again that the heads of rails do bend over. Perhaps no one has taken greater care, or gone deeper into this study than this gentleman. I myself have seen the heads of rails bent over even in their centres, so much that if they were cut off and placed against a new rail, it would be an absolute impossibility to prevent the wheel from jumping the new rail.

As regards creeping, my opinion is that this strain should never be borne by the joint at all. Take off as many as possible of the strains from the joint. It is already overcrowded: why then add another burden to the weakest part of the construction? A very simple form of fastening, fixed in the centre of the rail, will stop creeping better and more effectively than any contrivance at the joint. Fish plates or angle plates were originally intended to uphold the ends of the rails and keep them in continuity. This is enough for any combination of pieces of metal to do, without adding any unnecessary strains to it by attempting to make this combination also stop the rail from creeping. C. E.

[The Cloud joint consists of a pair of double-angle bars, with vertical webs projecting below the flange of the rail. There are four bolts through the rail and angle bars, and two bolts under the rails. Splice bars of this pattern, but without the bolts through the lower webs, are extensively used in Germany. With this explanation we leave our correspondent to have his say, as we have had ours, simply noting that we do not agree with him in a number of points, and that he attributes to us certain words, as virtually "correct spiking," which are not ours. Our remarks as to correct spiking referred to the maintenance of line of the track].—ED. ENG. NEWS.

The Extinguishing of Fires.

BOSTON, MASS., Dec. 31, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: The issue of your paper of Dec. 21, contained a letter on "The Prevention of Conflagrations," the spirit of which in the suggestion of measures for the prevention of fires or their extinguishment in early stages would, of course, be endorsed by every one having at heart the interests of the permanency of buildings.

The advice of the article in regard to the protection of stairways, elevators, and the like is certainly in accord with the results of widely extended experience on such matters; but exception must be taken to the suggestion for the use of reservoirs of carbonic acid gas suspended near the ceiling for the purpose of extinguishing the fire by its liberation when the temperature reaches a certain point. Let us consider the conditions of fire and the necessary condition for its extinguishment, and then see what conditions would be necessary in order to apply the gas to accomplish the purpose.

Combustible material burns when there is the coincidence of two conditions: first, that it is raised to the temperature of ignition, which in the case of wood is about 600° Fahr. for rapid ignition; and secondly, that it must be supplied with the oxygen of the air. With the exception of a few chemicals, to stop the combustion, one of these two conditions must be removed, and to extinguish it permanently the temperature of the whole must be reduced below the ignition point. If air is cut off from a burning mass of material, the combustion ceases; but it will start again as soon as air is readmitted unless measures are taken to cool down the burning mass by radiation or by conduction until the temperature is reduced below the ignition point.

Years ago it was presumed that steam could be used very advantageously for extinguishing fires, and many buildings were confidently fitted up in this way. Rooms of 180,000 cu. ft. capacity were supposed to be protected by a single 2-in. pipe leading from the boiler, on which the steam was frequently at very low pressures, and at no pressure at all on Sundays, except in cold weather. Under such circumstances, fires were not extinguished by the steam, owing to lack of capacity of the plant as well as its condition, and much valuable time was wasted. When steam jets were applied to smaller rooms, they would sometimes quench the fire for the first instant, but when the windows were blown out, there would be an accession of air much greater than the capacity of the steam to displace. The exception has been in the case of oil refineries, where one or two pipes 6 ins. in diameter, supplied with steam at 80 to 100 lbs. pressure, lead into each room. Under these conditions, there is a large enough volume of steam to displace the air, and the amount of combustible matter is relatively small, because the oil burns upon its surface and tanks are so arranged that the under portion of the oil can be drawn away.

It is well known that in large buildings, unless the fire is extinguished quite near its inception, the total destruction of the building is almost inevitable. That such a result is to be expected can be seen by consideration of the calorific capacity of the floors alone of masonry buildings, such as are used for manufacturing and warehouse purposes in all cities.

The temperature of a large fire may be so high as to evaporate a stream of water of 200 to 250 gals. per minute played towards the burning building, without permitting a single drop of water to enter into the windows. Such incidents are unusual, but still have occurred often enough to be well established.

The combustion of a pound of wood will produce, according to the best authorities, 7,200 H. U. To boil and evaporate one pound of water furnished at a temperature of 60° requires 1,119 H. U.; therefore the complete combustion of one pound of wood would evaporate 6.43 lbs. of water. The floors of mills and warehouses, with timber beams, weigh about 25 lbs. to the square foot, and therefore contain a sufficient amount of combustible material in every square foot of floor to evaporate 160 lbs. of water, or enough to cover the floor 2 ft. 7 ins. deep; and this disregards the contents which generally constitute the initial hazard of a building. It is therefore no wonder that buildings burn to destruction unless the fire is extinguished in its very inception by buckets of water, hand hose, automatic sprinklers, or the prompt action of the fire department. Thus after a certain stage in the progress of a large fire, the function of the fire apparatus is not equal to the extinguishment of the fire, but only to prevent it from spreading.

Suppose, on the other hand, that in accordance with the suggestion of your correspondent, we should have a supply of carbonic acid gas sufficient to displace the air in the rooms of the building. The gas must be kept under as great pressure as may be feasible; and suppose that canisters should be used for the purpose, in the form familiar in connection with the lime light used for projecting pictures on a screen with the stereopticon, and also for theatrical purposes. These canisters, measuring 15 in. in diameter, have a capacity of 1.23 cu. ft. for each lineal foot, and if they were made strong enough to sustain a pressure of 285 lbs. above that of the atmosphere, the gas would be condensed to one-twentieth of its volume. If the rooms were 15 ft. high, the cans lying horizontally would require 0.61 lin. ft. of can for every square foot of floor, or 0.61 sq. ft. of an space for 1 ft. of floor. This would about cover the

ceiling with cans, allowing enough room for hanging strips coming down from the timber above. It is unnecessary to allude to any devices by which such apparatus should be put into service at a fire.

The liberation of a volume of gas equal to that of the air would impose great strains on the structure if closed tightly, that on a window 4 x 7 ft. being three tons.

I have at some length applied the logic of figures to prove by the *reductio ad absurdum* the fallacy of a scheme which is as preposterous as that of the mice to bell the cat; yet the result of laboratory experiments with carbonic acid gas has made such a strong impression that the opinion is widely prevalent that it can in like manner be applied for practical purposes in the extinguishment of fires without the aid of water to furnish the necessary reduction of the temperature, when the mass is too large to cool by radiation as the heat of combustion ceases.

C. J. H. WOODBURY.

A MILK PIPE LINE COMPANY has been formed at Middletown, N. Y., with a capital of $600,000 to deliver milk to the metropolis; which it is claimed can be done at a profit of one cent per gall. within an hour or two for any distance under 100 miles. The milk is not piped as a fluid in the pipe, of course, but enclosed in large cylindrical cans, surrounded by water, which propels them. The system is ingeniously worked out, and seems to have elements of promise in it.

The Finances and Public Works of New York.

The report of Mayor GRANT shows that New York City, on Jan. 1, 1890, had a net debt of $95,121,657, which added to the Sinking Fund makes a total debt of $140,698,128. There was an increase during the year past of $7,001,251, due mainly to the expenditure of $9,057,000 for new parks, $1,600,000 for the new Croton Aqueduct, $1,217,532 for the Board of Education, $385,000 for the new Harlem Bridge, etc. The Controller disbursed $70,069,729.69 during 1889, and received $69,876,324. The Chamberlain's book shows receipts of $95,877,928.08 for the year, and payments of $96,840,209.11.

In regard to the public works of New York, the city now receives 96,000,000 galls. of water daily from the old Croton Aqueduct, and 16,000,000 galls. per day from the Bronx supply. This is the present maximum supply, but it does not meet the legitimate demand by several million gallons per day, and the pressure in the mains is correspondingly decreased. The present total length of the distribution system is 654 miles now in use.

The total area of paved streets on Manhattan Island is 3,181,260 sq. yds., with 171,368 sq. yds. added during the year on new uptown streets, and 64,724 sq. yds. of new pavement laid to replace worn-out material under the annual repavement appropriation. The first-named streets were paid by assessments on property benefited.

The sewers of the city aggregate 432½ miles in length, with 5,194 receiving basins. During the year 3½ miles of new sewers were built. To light the city now requires the use of 23,604 gas lamps, 1,331 electric lights, and 126 naphtha lamps. Under the present crusade against overhead wires, the Bureau of Incumbrances has removed from the streets of New York, since Jan. 1, 1880, 1,009 telegraph poles and about 12,600,000 lin. ft. of "defective, dangerous, or dead electric wires."

The city revenue from the Departments during the year was—From water rents, etc., $2,128,114 and from vault and sewer permits, $150,470. The Street Cleaning Department received an appropriation of $1,272,040; and $57,250 was received in addition for trimming scows, etc., though this last sum was paid into the city treasury and not used in the Department. The work done included the sweeping of 350 miles of paved streets, equal in all to 52,112 miles, and the collection and removal of 1,148,249 cart loads of ashes and garbage.

Since the beginning of the work, up to and including Dec. 1, 1889, the total amount expended on the New Croton Aqueduct, has been as follows:

Vouchers, payrolls, etc.	$ 2,595,399.28
Contracts and agreements	18,534,495.84
Land and land damages	50,482.12
Expenses, Commissioners of Appraisal	1,408 611.85
Total	$22,588,989.09

English and American Railways Compared.

Mr. EDWARD BATES DORSEY has recently read another paper in England on the above subject, in which he gives the subjoined table, continuing his statistics, in somewhat less extended form, down to 1888. Mr. DORSEY says as to the table:

operated lines with over 1,100,000 cars and carriages constructed and run on the principal advocated in this paper; against 19,812 miles of lines operated in the United Kingdom.

The substance of Mr. DORSEY'S argument is undoubtedly correct, and his conclusion, that American railways are operated more economically and

ENGLISH AND AMERICAN RAILROADS COMPARED IN OPERATING EXPENSES.

COMPILED BY EDWARD BATES DORSEY, C. E.

1888.
£1 = $4.80 1d. = 2 cents.

All figures representing cost are in PENCE, except the average cost per mile of railway operated, which is in POUNDS.

Calculated £1 = $4.85.

	Penn. R. R.	L. & N. Knoxville Branch.	English Railways. L. & N. W.	Gt. No.	Midland	Gt. W.	Gt. E.
Average cost per mile of railway operated, in Pounds	*£13,215	£8,070	£52,647	£39,400	£53,466	£20,046	£40,714
1. Percentage of total tonnage mileage transported East	77	30					
2. Percentage of total tonnage mileage transported West	23	70					
3. Average tons in loads of freight trains	214	154	79	59	6.	64	62
4. Average charge for transporting one ton one mile	.317	.405	1.00	1.00	1.00	1.00	1.00
5. Percentage of operating expenses to earnings	64	58	52	50	52	49	54
6. Percentage of operating expenses to earnings on the Pennsylvania Railroad Division, provided it charged the same rates for freight as are charged on the English Railways, viz., 1d. = 2 cts. per ton per mile			20	20	20	20	20
7. Percentage of increased earnings that the Pennsylvania Railroad Division would receive if it worked with their present operating expense and received the same freight rates (1d. per ton per mile), as the English railways now receive			615	615	615	615	615
8. Percentage of "traffic expenses (coaching and merchandise)" to total operating expenses	35	32	36	34	34	29	31
9. Average cost of transporting one ton one mile. The cost for the English railways is found by multiplying the estimated charge of 1d. per ton per mile by the percentage of operating expenses to the gross earnings, as per paragraph 5 above	.206	.272	52	.50	52	.49	.54
10. Average cost of transporting one ton one mile, deducting on the English railways all "Traffic Expenses (coaching and merchandise)," and deducting nothing from the total operating expenses of the American Railroads	.206	.272	.333	.370	.343	.348	.373
11. Average cost of transporting one ton one mile deducting all "Traffic Expenses (coaching and merchandise)" on all roads	.134	.171	.333	.370	.343	.348	.373
12. Average cost of train mile—freight and passenger	42.06	35.50	33.26	27.51	27.40	28.77	27.76
13. Equated cost of train mile on the English railways, provided they transported their present train loads at the same cost per ton per mile as is done by the American railroads, to which they are compared			15.52	11.13	12 00	12 58	12.19

* Exclusive of equipment.

The preceding table shows that on the English railways, which have cost from four to six times more to construct than the American roads, the cost for transporting freight is more than double the American cost, whereas it should be less, or why make the increased outlay for superior construction?

The author thinks that the great difference in favor of American railways in the cost of operating expenses is owing principally to the following reasons:

1. The trains on the American railways carry much larger loads than those on the English roads.

2. The universal use on the American railways of rolling stock, with bogie-trucks, which run with much less friction and wear and tear than the English rolling stock with its long, rigid wheel base.

3. The general use on the American railways of freight cars, carrying a greater percentage of paying load to dead weight than those used on the English railways.

4. The lower speed at which the American goods trains run.

5. The use on the American railways of heavier locomotives which haul heavier loads than can be done by the lighter ones used on the English railways.

6. The use of locomotives on the American railways with outside cylinders and connections, which can be more cheaply and easily repaired than those with inside cylinders, used on the English railways.

7. The use on the American railways of collecting and distributing goods trains, which load and unload at the station goods in less than car-load quantities, thus avoiding having wagons only partially loaded, as is the custom on the English railways. In this the Americans apply to their goods trains the same principle that the English railway managers now apply to their milk trains.

The present freight charge on pig-iron from Stoke-on-Trent to Liverpool is 5sh. 5d. ($1.30) per ton, distance 55 miles. From Birmingham, Ala., to Pensacola (both in the United States), the freight charge is $1.40 = 5 sh. 10 d., distance 280 miles, the freight being about the same for five times the distance. This is a practical illustration of the difference between English and American railway practice, and its effect upon the trade of the country. The Birmingham district in the United States is only three or four years old; it will produce this year over 800,000 tons of pig-iron. With railway freights as high as they are in England, the iron could not be profitably made, and the whole district would be depopulated and abandoned.

The preceding remarks and opinions are founded upon actual workings of many years of all the American and Canadian railways, embracing over 170,000 miles of

effectively than the English, is as certainly sound. But that there is as great contrast as he thinks, or as his figures seem to prove, we do not believe. Mr. DORSEY hardly allows enough for the effect of the enormous difference in average haul on freight, 110 miles here against only 35 miles in England. Even in New England the average haul is 56 miles, and the effect is not only to make the terminal charges a heavy addition per mile, but likewise to make the actual transportation expenses per mile far heavier. Mr. DORSEY allows for the great and obvious difference in terminal expenses by remarking, with truth, that the whole terminal expenses may be deducted in gross from the English cost per ton-mile and yet leave the latter far higher than it is in this country; but in addition to this, the effect of the short haul is to greatly impede loading all trains up to their full capacity, which is the greatest by far of all the contributing economies to the remarkably low cost of transportation in this country.

So much we say as a mere matter of justice. To assume that the real contrast were as great as the face of Mr. DORSEY'S figures indicates, would be to argue that the English are a nation of fools, something which their worst enemy would hardly accuse them of. But that the contrast is very greatly to the disadvantage of the English after all proper allowances are made, no really intelligent man, who studies the question impartially, will deny; and there is, moreover, this highly significant feature of the situation,—that, whereas enormous yearly strides toward still greater economy are made in this country, until it seems as if the process of reduction of rates (and of expense with it, for the percentage remains nearly constant) would never stop, not the least sign of such a tendency is visible in England, in spite of heavy growth of traffic there as here. Twenty years ago (we do not stop to look up the exact figures) our freight rates and expenses were quite as high as theirs. Since then, they have fallen enormously and continuously here, and little if any there; whence all the present sharp contrast.

It is not possible to explain these facts away in a manner which will be very gratifying to English vanity. The true explanation of a large

part of the otherwise unexplainable residue, we believe (for we do not propose to let the American Eagle scream unjustly) is that circumstances have operated to compel extreme economy here much more powerfully than in England, in that our hauls were so long, and there was such a vast volume of freight which had to be hauled cheaply if at all. But after all rational allowances have been made on this account, there still remains too much contrast between English and American railway rates and expenses to be explained by any other supposition than that English railway management is less live and less progressive than is our own.

Board of Trade Action on Railway Safety Appliances.

The full text of the circular issued by the English Board of Trade to the various railway companies, referred to in our discussion of the current report of the Interstate Commerce Commission, is as follows, omitting only a few formal sentences. The circular bears date of Oct. 24, 1889:

I am desired by the Board of Trade to request that you will call the attention of the Directors of your company to the provisions of "The Regulation of Railways Act, 1889," and to state that the Board proposes to take the following action under the several specified provisions:

SECTION I.

(*a*) The Board of Trade propose to order every railway company to adopt the block system on all their railways except such single lines as are worked on the train-staff system without tickets, and short branches upon which only one engine in steam or two or more engines coupled together are upon the branch at the same time.

(*b*) To order every railway company to provide a system of interlocking of points and signals which will satisfy the existing requirements of the Board of Trade for new lines, a copy of which is enclosed herewith, upon all their lines in respect of all places where there are connections with passenger lines. Locking of points upon single lines by means of train staff or tablet, and all siding points near stations upon double lines by means of Annett's key will be accepted.

(*c*) To provide for and use on all their trains carrying passengers, continuous brakes complying with the requirements set out in Section I. (*c*) of the Act.

As regards the last portion of the order, I am to state that the Board of Trade, as at present advised, are disposed to assent to such modifications as will allow of a limited proportion of unbraked vehicles—not carrying passengers and not exceeding one-sixth of the total number of vehicles—to be used on passenger trains, provided that in no case is the rear vehicle of the train to be one of those unvalved; and to permit upon certain exceptional lines, where the running of mixed trains can be justified, a number of unbraked goods wagons or other vehicles—not exceeding one-half of the total number of vehicles—to form part of such train, provided that, in this case also, a brake capable of being worked from the engine is attached to the rear vehicle of the train.

The Board of Trade propose that the time limited for compliance with the Orders should not exceed:

For the adoption of Block working	One year.
" " " Interlocking..	Eighteen months.
" " " Continuous Brakes....	Eighteen months.

SECTION VI.

The Board of Trade propose to fix the 1st day of July next as the date from and after which every passenger ticket is to bear upon its face the fare chargeable for the journey.

I am, however, to state that the Board of Trade will be willing, before issuing the orders, to consider any representations which your company may desire to address them, provided that such representations are submitted within two months from the present date.

The specified two months' limit expired Dec. 24, so that positive action in the direction indicated may be expected now at any time, since it is not likely that any of the communications received will be of such weight as to change so deliberately expressed a purpose. The time is yet far off when similar action is likely to be had in this country in respect to block working and interlocking.

The Toronto Esplanade Question

The following is the conclusion of Mr. WELLINGTON's report on this question, continued from last week, when we gave two maps showing the existing and proposed situation:

In more detail, the plans above recommended may be summarized as follows,

THE UNION STATION.

The block now occupied by the old Parliament buildings is about 940 ft. long, by 415 ft. deep, the width of Front Street on the south of it being about 83 ft. By placing the south wall of the new station on or near to the south line of Front St., as shown in Fig. 2, the street being deflected north around the front of the station, there will be room for a union station 175 ft. wide, containing 6 or more tracks; for a street or piazza in front of that of about 123 ft., and yet leave 200 ft. of the block in depth fronting on Wellington St., or nearly half of it available for sale.

It does not admit of doubt that this residue, with the Union Station built, would be worth more than the whole block is now or otherwise will be. Among other desirable uses to which it might be put, it would furnish a most admirable site for a large hotel. The block being now public property, the rear half of it, reserving 200 ft. in depth along the Wellington St. front, might appropriately be given by the province to the city, on condition that such a union station as herein proposed be erected upon it. But whether this be done, or whether the entire block be bought from the province by the city, there is no reason why the land for the station should cost the city anything, and I therefore do not include any allowance therefor in the estimate below.

A station containing 6 passenger tracks would require a train room about 120 ft. wide, and should be about 700 ft. long, the train shed of the present station being only 430 ft. long. This would leave available a space 55 ft. wide and 700 ft. long for waiting rooms and offices, which would be more than ample for all requirements. The most suitable level for the tracks would be at about 23 ft. above the city datum (15¼ ft. above the tracks in the present Union Station, and about 2 ft. above the present level of Front St.)

The foundations of such a structure in this location will not be expensive, and the sum of $500,000 will be ample for the erection of a building in all respects worthy of the city, and adequate for the needs of the city for the next twenty or thirty years at least. Possibly $400,000 or less would suffice. Careful estimate for a very much larger structure in the city of Buffalo, 340 ft. total front, by 800 ft. total length, with a train shed 280 ft. wide by 670 ft. long for 14 tracks, and surmounted by a tower over 200 ft. high, showed a total cost of $700,000 only.

Back of the station there should be placed two tracks for freight use, as shown in Fig. 2.

PASSENGER CAR STORAGE GROUND.

It will be necessary, or at least desirable, in order to save needless switching, that there should be a considerable number of storage tracks for passenger cars in the immediate vicinity of the station, and on the same level therewith. Provisions are then stated, as shown on map, to leave available where Front St. now is, a space 600 ft. by 100 ft. or more, which will easily suffice for storing 40 to 60 cars. This is enough for all legitimate needs of such a yard, which is merely for cleaning cars and temporary storage between trains. There are many important stations which have no storage ground available without a considerable haul.

THE WEST APPROACH.

The four tracks of the west approach should start from Bathurst St., and follows substantially the present line and grade to a point about midway in the block between Bathurst and Brock Sts. There will, therefore, be a rise of about 15 ft. to be made in a distance of about 2,600 ft., giving an up grade of about 30 ft. per mile. So far from this being a disadvantage, it is to be preferred to a level, tending to help to start trains out quickly from the station, and stop quickly in approaching it. In fact there would be no very serious engineering objections, in my judgment, in starting the ascending grades from the vicinity of Brock St. and making an ascent of 15 ft. in a distance of about 1,500 ft. or at the rate of 1 in 100. This would have the advantage of requiring no change in the present Brock St. bridge, but for various reasons I am not prepared to advise it.

THE EAST APPROACH AND ESPLANADE VIADUCT.

Starting eastwardly from the station the four tracks strike diagonally across the block between York and Simcoe Sts. south of Front, passing nearly through the centre of the Marlborough House, the only building to be destroyed to carry out these recommendations, and striking the line of the present Esplanade track just east of York St. Shortly after leaving the Union Station, about in the middle of the block north of the present Union Station, it is proposed that the line shall pass upon a four-track iron viaduct, similar in its general plan to the elevated railways of New York, but planned for heavier rolling loads, and pass thence eastwardly through the centre of Esplanade and Mill Sts., to a point between Cherry and East Sts., making the total length of four-track viaduct about 7,800 ft. (1.48 miles). Here the viaduct will fork into two double-track structures, one branch for the Grand Trunk Railway, continuing on to and across the Don River where the present Grand Trunk bridge now is, about 1,800 ft. (0.34 miles), and the other for the Canadian Pacific Railway, curving to the north and slightly descending to and across Eastern Ave., which it crosses with about 13 ft. clearance, enabling a connection to be easily made with the Canadian Pacific Railway tracks along the Don River.

The grade of this structure I should advise to be a level at an elevation about 20 ft. above the present tracks in Esplanade St. This requires a slight rise of 5 ft. in the approach from the Union Station, which can be made by a grade of 1 in 300 between York and Yonge Sts.

For practical purposes we may consider the total of iron viaduct as equivalent to 9,600 ft. (1.82 miles), of four-track line which would be constructed under what are called "consolidation specifications," fit for any working loads or speeds likely to be required. Such a structure can be constructed in the best manner for $160 per ft. as an outside estimate, or $1,536,000, which amount will include the cost of foundations and of a double-deck drawbridge over the Don River, as below noted, in place of the present fixed spans. Should the competition be sharp and the prices of iron low, its cost might be considerably less.

With this viaduct built, and with no dangerous level road crossing beyond it, passenger trains can easily average 30 miles per hour over it or pass it in about 3.2 minutes. If limited to six miles an hour over the same distance, as they must be to operate tracks on the street level with safety, they must take about 18.13 minutes to pass over the same distance, a saving of nearly 15 minutes. This is a great consideration for suburban trains, and even through trains, being equivalent in time to the saving of nearly ten miles in distance between Toronto and Montreal. For the effective conduct of a local city service below alluded to, it is a *sine qua non*.

BEYOND THE DON RIVER.

The connection of the Grand Trunk tracks beyond the Don River with the elevated tracks should be made by an earth fill along the present line. If the level of the elevated tracks be continued on a level until it strikes the grade of the present tracks, it will strike them in about 3,300 ft. from the Don crossing, raising the level of the tracks at Queen St. about 7 ft., and at Eastern Avenue about 14 ft.; thus greatly facilitating the construction of subways at those streets, which should be put in while the fill is making, but the cost of which I do not include in the estimate for these proposed works, for the reason that subways are now needed there in any case. Rather, there should be a credit in the estimate, as the cost of these subways will be much decreased.

THE GRAND TRUNK EASTERN YARD.

The important Eastern yard of the Grand Trunk Railway along the mouth of the Don River is by the above plan made much more convenient than it now is, since it may be all used for yard purposes only, without necessity of reserving tracks for through trains. It must, however, be provided with an eastern outlet, and to this end it is proposed to make the new drawbridge over the Don River a double-deck structure, the upper deck being for the elevated through tracks, and the lower deck carrying a yard track at about the level of the present tracks. After passing through the bridge from the yard, this track swings out around the base of the fill, and running slightly up grade along its slope, speedily connects with the through tracks. In this way access to the icing yard for refrigerator cars, and to the distillery cattle houses, as well as to Don yard in general, is fully preserved.

LOCAL FREIGHT YARDS.

The erection of the new Union Station at a higher level and further north, with the other improvements outlined, is not only nor chiefly to bring the passenger station nearer to the business center of the city, nor to save the great expense of constructing a high level station on lower ground, nor to improve the value of real estate along Wellington and other streets in the vicinity of the new Union Station; nor to improve the value of the water front and of real estate on both sides of Esplanade St.; nor to save danger to life and property from the constant passage of through trains along the water front. All these ends are important, and all them are fully secured, being alone sufficient to fully warrant the construction of the work above proposed. The main purpose of the particular plan outlined, however, is to free a very large space along the water front from all obstruction by through tracks and by passenger service, so that it may be devoted exclusively to local freight uses, thus providing both of the present companies with much better facilities than they have now or are seeking to obtain, and making unnecessary those further encroachments on the limited water front of the city which in my judgment have justly excited the apprehension and opposition of the citizens of Toronto, but which they cannot too early and too clearly realize are practically indispensable under the existing status, unless some such general plan as that here outlined is carried out; and for reasons I have above suggested, it cannot, with any justice or probability of success, be demanded that the railways shall agree between themselves to carry out these improvements at their own expense.

By the plan outlined, the large quadrangular area bounded by Front, York, Peter Sts. and the new "Windmill" or bulkhead line on the south, is released entirely

for local freight uses; a district 2,400 ft. long by about 1,250 ft. deep, an area of nearly 69 acres in all, which will suffice for all the legitimate needs of both companies in this location for a century to come, even without remembering that the Grand Trunk has just west of this district a further quadrangular tract 2,500 ft. long by about 1,400 ft. deep, or over 80 acres in area, with which it is not proposed to interfere in any way, and which gives the Grand Trunk Railway all the water front for which it has now or can ever have any legitimate use. Except that its large holdings have been acquired by consolidation of different independent lines, and largely while the city was small and land cheap, it is not likely that it would even have attempted to acquire so great an area along the water front as it now holds, nor is it at all necessary that any of this area should continue to be used for shops, storage tracks, making up trains, or through service of any kind. The last it is proposed to move to the elevated tracks; the other uses specified can as well as not buy other and cheaper land on the outskirts of the city, when and as traffic increases so as to demand it, which will not be for many years.

It is therefore proposed, as an essential part of the scheme of adjustment herein outlined, that the Grand Trunk shall surrender to the city, at a fair valuation, the freehold and leasehold tracts now held by it in the southern part of the local freight district first above described, where it is proposed to place the Canadian Pacific Railway freight yards. The local freight district, between Peter and Yorks Sts. should be divided between the G. T. R. and C. P. R. Companies by an east and west street, the precise location of which I am not prepared now to recommend without further study of the local conditions, but which should be substantially an extension of Esplanade St.

This adjustment should include a concession to the C. P. R. of right of way for two yard tracks across the Grand Trunk property to the west (which I believe the C. P. R. already has secured); and some further details of minor importance, needless to here particularize, which may yet give trouble if not arranged in advance.

THE GRAND TRUNK LOCAL FREIGHT YARD.

By these arrangements the Grand Trunk gains first, a release of the present Union Station, and the large block on which it stands, 685 x 285 ft., from passenger use, enabling the building and lot to be converted to freight use; secondly, a release of all tracks now kept open for passenger and through freight uses, enabling them to be reserved for local freight uses; thirdly, a release of all tracks now required for passenger car storage. Considering the improvement in quality as well as quantity, this amounts to fully doubling its local freight facilities east of Brock St.

THE CANADIAN PACIFIC LOCAL FREIGHT YARD.

The C. P. R. gains by this arrangement, first an unobstructed stretch of 2,400 ft. of water front, and secondly an area about 2,400 x 750 ft. (41.3 acres) of wholly unobstructed yard room, except for the fact that the pump house of the city water-works stands near one corner of the area, and must retain adequate wharf rights for landing coal, and perhaps land for placing additional pumps in the future. All this can be done without seriously interfering with the laying out of the yard or seriously reducing its effective area.

The tract between Yonge and Simcoe Sts. which the Canadian Pacific is now endeavoring to secure, and for the most part has secured and paid for, and the conversion of which into a railway yard has excited such strong local opposition, is only 2,075 ft. long by about 740 deep (to the new Windmill line) or about 35 acres in area, less than 15 acres of this being inside the old Windmill line, whereas nearly all of the 41.3 acres, which it is proposed to give them in lieu thereof, is inside of that line. The C. P. Ry. is also saved the large expense of constructing two overhead bridges across this tract, which with other necessary improvements of that nature, become no longer necessary, may fairly be placed at $200,000.

THE C. P. R. PROPERTY EAST OF YORK STREET ON THE ESPLANADE.

All the property which the C. P. R. has acquired east of York St., and all the work which it has done thereon, I propose shall be assumed by the city at cost, not by returning the money, but by crediting the C. P. R. with the interest on that capital in reduction of its annual rental for use of the Union Station and tracks connecting therewith. The same method I should propose for adjusting all the real estate transfer with both companies, as below more fully outlined.

This property being turned over to the city, the question arises, What should be done with it? It may probably be disposed of by the city in time for all or more than it cost, keeping in view the improvement in the character of Esplanade St. which will result from elevating the tracks, but if there be sufficient public spirit in Toronto to permit of it, there is the other and far better use for it alluded to above.

A WATER-FRONT PARK.

I should recommend that the entire area turned over to the city as above, between York and Yonge Sts, be converted into a public water-front park, 1,600 ft. long by 700 ft. deep, and containing 25.7 acres; that the rather shabby structures which now accommodate the yachting, boating, Island ferries, and pleasure steamboat travel of the city, should be replaced by buildings of a more ornamental character, along portions of this Park water front, under strict restrictions as to character and management, and that in addition there should be pavilions, music stands, etc., for the general use of the public.

All the work which has so far been done along this water front by the C. P. R., and which it is proposed that the city shall assume, is adapted directly to this use. The cost of continuing and completing the work, so as to make a finished park, will be so moderate that it may safely be assumed that no city of the size of Toronto will ever have obtained so fine a park so cheaply. The opportunity is one which, if now neglected, is never likely to return, and it would be a discredit to the city if it should not eagerly avail itself of it, should it occur.

SURFACE TRACK THROUGH ESPLANADE STREET.

There are now six of these tracks, four of them for through trains, and two of them used for local freight delivery. Over all these tracks locomotives are freely used at all hours.

I should recommend the removal of all these tracks, and the substitution for them of two rather heavy street-car tracks over which switch engines could pass with safety, but over which they were permitted to pass only between the hours of midnight and 6 A. M. Except between those hours I should advise that all delivery of freight along these tracks between York and Berkeley Sts, be done by horses.

Such use of horses for switch work would probably prove to be more economical in this locality than the use of locomotives, in addition to which it would entirely do away with a nuisance and public danger. Four horses and a couple of boys would easily do the work here of a switching engine, and throughout Europe, as also in New York City, horses are extensively used in this way. Elsewhere on this continent locomotives are almost exclusively used, it may be admitted, but often with questionable judgment. At the most, there could be no serious difference either in convenience or expense resulting from the use of horses only along the Esplanade, for eighteen hours out of twenty-four.

This change made, the present system of delivering freight along the street, by stringing cars along the street and allowing whoever has a key to a car to help himself from it, could be continued unchanged; but I should further recommend, not at all as a necessary part of this scheme, but from a general regard for the good name of the city, that this uncouth and primitive system of freight delivery, by which the whole of the principal water front street is in effect turned into a local freight yard, be abandoned altogether. It may be well enough for some straggling country village (although few such in fact permit it), but it is entirely improper for a city like Toronto,—an injury to all, and a real benefit to none.

THE IMPROVEMENT IN ESPLANADE STREET.

The result of all these changes could not but be a very marked and rapid improvement in the value of property on both sides of Esplanade St., and of the water front generally. New York experience indicates that the existence of a four-track elevated railway through the centre of a business street of this kind and of this width would not sensibly decrease the value of property along it, while the park improvement, the street car service, the freight delivery within the buildings, and above all the removal of the surface locomotive tracks, would greatly tend to increase it.

How considerable the increase in valuation along Esplanade St, is likely to be, is evident from the fact that the present assessed valuation of all the property along both sides of the streets between York and Parliament Sts. is $1,525,740, along a frontage (counting both sides of the street) of 6,674 ft., if I am correctly informed. With the improvements carried out, the probable increase in valuation of this street alone would go far toward covering the entire cost of improvements herein suggested, but there is in addition the probable increase in valuations along Wellington St. and elsewhere in the vicinity of the new Union Station, and the general improvement to the valuations of the whole city, which would result from so material a betterment of the most conspicuous part of it. As the city, however, derives rental from these improvements also, the case in favor of their construction is very strong.

SUBURBAN AND CITY TRAIN SERVICE.

These conditions (details omitted, ED.) in addition to the saving of 10 to 15 minutes time on every train entering the city, render at once possible a local "rapid transit" service over the circuit of 15¼ miles which the Canadian Pacific Railway now has within the city limits, or will have as soon as all its tracks are laid. This circuit can be made by local trains in one hour with great ease, making stops every half mile on an average, or 30 stops in all, so that two trains would afford a half-hourly service, and two trains more during a few hours of the day only would give quarter-hourly service. The circuit might possibly be made in 45 or 50 minutes. In my judgment such a service would more than cover expenses even in the first year, and develop into a most profitable traffic later, while it would be a great public convenience, and its effect upon the development of the outskirts of the city, and upon the value of property there, would certainly be important. Without the improvement along the Esplanade herein outlined, such a service is practically impossible. The time would be lengthened at least 15 minutes, and so large a proportion of the traffic would be driven to the horse cars as to make the whole service inexpedient. The local conditions are unusually favorable for such a service except along the water front, and to establish it is one of the strong reasons why the city should not hesitate to carry through these improvements, because the city has a far deeper interest than any railway can have in having such a service established. The profit from such trains over expenses will not become considerable for several years, and it is as nothing compared with its effect upon the value of real estate.

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There will be three or four times as many G. T. R. as C. P. R. trains using the elevated tracks, since the C. P. R. will use them only for passenger and strictly local freight service, while all the G. T. R. through freights will pass over it. Nevertheless, I should recommend, as above stated, that the rental charged for the use of the structure and station, whatever it may be, should be equally divided between the two companies, and that if at any time a third company should be admitted to the use of the structure (the right to do which, should any company apply for the same, and connect its tracks with the structure, should be explicitly reserved by the city) the same rental should be divided into equal thirds regardless of the number of trains, leaving each company to run as many or as few trains as it pleases. It is not likely that the tracks will be over-crowded by any possible traffic of the next half century at least, if operated as they should be, under joint management, and entirely by interlocking block signals and switches.

I advise this equal division of rental, first, because it is the only practicable one, it being quite impossible to say precisely what proportion of use each company enjoys; secondly, because a company has to go to the same expense in providing itself with such facilities, whether it runs one train a day or fifty over them; thirdly, because it seems only a proper concession in favor of the G. T. R., which is likely to run the most trains, in view of all the circumstances, specified and unspecified.

In proposing the preceding plan, reasonable and beneficial to all parties alike as it appears, I find myself confronted with the fact that I can advance no precedent for such an arrangement as this, the nearest to it being the arrangement for constructing the Grand Central Station and costly connecting subway entering the city of New York, to which the city contributed half the cost, or nearly $4,500,000, without securing any ownership interest or tangible return whatever except that of getting rid of the nuisance of surface tracks. That improvement also was and is used jointly by two companies. The proposed improvements at Buffalo are another similar case. As a rule, however, I am compelled to admit, cities stand quietly by until companies correct these evils at their own expense and of their own motion, or content themselves with bringing legal pressure to bear.

Frequently this policy is effective for the reason that when cities become large enough to make such improvements desirable, the leading railways running to them are usually rich. Such is not the case in Toronto. The railways are both of them comparatively poor. Usually also there are many more corporations to be conciliated and arranged for, and the smaller the companies the more trouble they make, so that any arrangement of the kind here proposed is impossible to arrange for. It is rare indeed that eight different companies once entering city will have consolidated into two.

Moreover, it is extremely rare that a city is in such imminent danger of serious injury, which it can only arrest by some active enterprise on its own part, as is Toronto at this moment. It cannot be too often nor too earnestly impressed upon the citizens of Toronto that the railways by their own unaided efforts cannot do much better by the city than they are now proposing to do, and ought not to be asked to do. The Grand Trunk, as the first comer, has certain property, which it has bought and paid for. Whether more than it needs or not, it cannot be expected to turn over part of its property, which it may possibly find some use for in the future, to smooth the path of a rival to compete with it, without some compensating advantages to itself, which the rival cannot offer. Neither can its interloping rival expropriate this property. For one railway to expropriate from another is dubious process, even when necessity can be shown, but in this case no necessity can be shown by the C. P. R., for that company can go, and has gone, further along on the water front and found property suitable for its needs which it has bought in the open market.

But I cannot regard the absence of any exact precedent for such a plan as I have recommended herein as any real objection to it, or reason why it should not be

carried out. The real difficulty lies in impressing on a great municipality the necessity of united and prompt action. Should this be obtained, there will not be any serious difficulty in obtaining the assent of the railways, since the arrangement herein proposed is greatly to the advantage of both of them, and they would be placing themselves in an odious and indefensible attitude before the public should they persist in antagonizing it, an attitude which no great corporation wishes to take or remain in. But, failing some such public action in aid of a more rational solution, I am unable to see how any better arrangement can be effected than that which is now propcsed and in process of execution, which will leave the City of Toronto with over two-thirds of the water front occupied by railway yards, and with access to the remaining fraction obstructed by six railway tracks on the level, over which locomotives and through trains are constantly running.

Despite all the relief that can be obtained by overhead bridges, the growth of population and of railway traffic will soon make this situation so intolerable that relief from it will then be demanded at any cost. Such relief can be obtained in advance much more cheaply and effectively than it can at any later date. It remains to be seen whether the citizens of Toronto appreciate this fact and take the necessary action while there is yet time.

The report of Messrs. C. S. GZOWSKI, of Toronto, and WALTER SHANLY, of Montreal, rendered Sept. 17, 1889, was accompanied by a report from GRANVILLE C. CUNNINGHAM, Asst. City Engineer, and VILLIERS SANKEY, City Surveyor, the two really constituting one report. The report dwelt strongly on the vital importance of preserving the city water front and freeing it from existing obstructions. The objections to overhead bridges, on account of the necessary lamps and long approaches, as well as of cost (estimated at $1,000,000 for four crossings) were forcibly pointed out, and an elevated structure stated to be the only proper remedy. The report differed from Mr. WELLINGTON'S, however, in proposing to make a solid masonry viaduct through the Esplanade, on the ground that it was cheaper, and also proposed to run the tracks down to surface grade before reaching the Don River crossing (see map in our last issue). The report also curtailed the C. P. R. freight yards within smaller limits; that is, from John to York Sts. only, and not including control of the water front.

The report of Messrs. J. H. ARMSTRONG and JOHN GALT, Civil Engineers, rendered in October, 1889, differed from the two preceding reports (1) in proposing a two-track viaduct only through the Esplanade, and (2) in throwing the proposed Union Station further south on to the Grand Trunk property. The further details of the report, which was an able and carefully marked out document, we regret that we cannot give space to, since they are chiefly of local interest.

After these reports had been rendered, several conferences of the engineers who prepared them were called, as we have noted. Their several reports to the Esplanade Committee, which showed substantial agreements, we need not summarize, but aided by them, that committee has lately (Dec. 24, 1889,) submitted a single scheme for the solution of the Esplanade difficulty which agrees in all points with Mr. WELLINGTON'S original report, except as follows:

1. The four track iron viaduct is recommended to be so designed that only two tracks need be erected for the present, leaving the additional tracks to be added only when and if needed.

2. A solid metal and ballast floor is specifically recommended.

3. The new Union Station is recommended to be placed on the north part of the Grand Trunk freight yard, instead of on the south part of the Old Parliament Building block, just north of it.

4. The Canadian Pacific yard is curtailed by stopping it on the west at the City Water Works.

The recommendation as to the ownership and management of the works are the same in substance as in Mr. WELLINGTON'S original report.

The total cost of the improvement is estimated at $2,175,000, of which $1,100,000 is for the viaduct, and $500,000 for the new Union Station.

In this position the question now stands. It remains to obtain the consent of the two railways concerned to these details, or failing that, to obtain legislation which will compel such consent. It appears to us altogether likely that the works will be carried through substantially as now planned, since it is readily shown to be best for all interests that they should be.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Baltimore & Drum Point.—A correspondent writes us the following concerning this enterprise:

The road is to run from Baltimore, Md., through Anne Arundel and Calvert counties, to Drum Point, a distance of 82 miles. The work is about average; maximum curve 5° and maximum grade 1 per cent. Rogers & Clement, of 247 West 125th St., New York City, are the contractors. About 57 miles of the grading has been completed and it is expected to have the entire line graded by May 1. It is expected that tracklaying will commence about March 15 and the road be completed and opened for traffic by Aug. 1. The principal business of the road will be the coal shipment to Drum Point and the local traffic. NICHOLAS GOLDSBOROUGH, of 10 South St., Baltimore, Md., is Chief Engineer.

Manistee & Grand Rapids.—A correspondent sends us the following:

This company was organized Nov. 25, to build a railway from Manistee to Grand Rapids, Mich., a distance of about 110 miles. The object of the road is to furnish an independent outlet for the large product of lumber and salt at Manistee, and to develope the pineries along the route. The preliminary survey has been completed for 18 miles from Manistee south and 7 miles of the line has been located. Grading was commenced Dec. 20 by the company's own forces and about 200 men are now at work on the road. It is intended to complete 5 miles this winter. This will connect several mills and salt blocks with the Flint & Pere Marquette R. R., and in connection with this road and the Manistee & Northeastern R. R. will form a belt line around Manistee Lake. The work on this 5 miles will be quite heavy, requiring the removal of 180,000 cu. yds. of earth mostly on a distance of two miles. The officers of the company are: President, JOHN CANFIELD, Vice-President, LOUIS SANDS, Secretary, T. J. RAMSDELL, Treasurer, E. G. FILER, and Chief Engineer, Col. E. W. MUENSCHER, of Manistee, Mich.

McKeesport & Belle Vernon.—This road running from McKeesport to Belle Vernon, Pa., recently completed has been sold to the Pittsburg & Lake Erie R. R. Co. The road runs through a fine coal and gas region and will be a valuable feeder to the Vanderbilt system.

Grand Trunk.—The contract for double tracking this road from Belleville to Gananoque, Ont., has been awarded to McArthur Bros., of St. Paul, Midh.

Central Vermont.—Surveys are in progress for the proposed line from Windsor to Bellow's Falls, Vt.

Cincinnati, Saginaw & Mackinaw.—At a meeting of the stockholders of this newly organized company the following officers were elected: President, A. W. WRIGHT, Vice-President, P. H. KETCHAM, Treasurer, W. R. BURT, and Superintendent, JAS. G. GARDNER.

Philadelphia & Seashore.—Fifteen miles of this road have been graded. The road is projected to run from Winslow to Sea Isle City, N. J., 35 miles.

West Jersey.—This company proposes to abandon the Ocean City R. R, running from Sea Isle to Ocean City, N. J., 11 miles. It will, it is stated, build a line from Belle Plain, on the main line, to Ocean City.

Columbus, Lima & Milwaukee.—Forty-three miles of this road from Lima to Defiance, O., has been graded ready for tracklaying. B. C. AUROT, of Lima, O., is President.

Projects and Surveys.

Trout Run.—This company has been incorporated in Pennsylvania to build a railway from Cammal to Hyner, Pa., a distance of 9 miles. W. L. TORBET, of Girard Manor, Pa., is President.

Troy & New England.—At a meeting of the stockholders of this company recently held the organization was completed by the election of the following officers: President, WALTER P. WARREN, Vice-President, W. A. THOMPSON and Secretary and Treasurer J. J. TILLINGHAST. It was voted to engage an engineer and commence the surveys for the road at once. The road is projected to run from Troy, N. Y., via Averill Park to a connection with the Lebanon Springs R. R.

Gossville & Dover.—The citizens of Northwood, N. H., are agitating the project of building a railway from Gossville to Dover, N. H., via Northwood, East Northwood, and West Barrington.

Norwich & Westerly.—A project is on foot to build a line of railway from Norwich, Ct., to Westerly, R. I., a distance of about 15 miles. It is proposed to use the tracks of the Norwich & Worcester R. R. from Norwich south about 4 miles to the Poquetanoc River and to build from this point east to Westerly. It is thought that the prospects for the construction of the road are good.

Clarion River.—A correspondent writes us that this road is to run from Carman Station, on the Buffalo, Rochester & Pittsburg R. R. down the Clarion River to Hallton, Pa., a distance of 12 miles. The route is through a timbered country and the principal business will be in lumber and bark. There will be one bridge of about 300 ft. WM. H. HYDE is President, and B.E. WELLENDORF, of Ridgeway, Pa., is Chief Engineer.

SOUTHERN.—Existing Roads.

Chesapeake & Ohio.—Surveys have been commenced under the direction of H. E. TALBOT, Assistant Engineer, for the proposed branch from Covington, Va., to Warm Springs, Va., 30 miles.

Charleston, Cincinnati & Chicago.—Work is being pushed on the division of this line between Rutherfordton and Marion, N. C., 35 miles.

Raleigh Springs.—Bids for the construction of this 11-mile Tennessee road have been called for. E. SCOTT, 258 Second St., Memphis, Tenn., is General Manager.

Kentucky Union.—The work on this road is rapidly approaching completion. The 20 mile division from Lexington to Winchester, Ky., is practically completed as far as the road bed is concerned. Track laying will commence this month. On the division from the Kentucky River east to Jackson the grading is nearly completed. It is expected to have the entire line in operation by March 28.

Projects and Surveys.

Carolina Southern.—W. G. CHILDS, JAMES WOODROW, and others of Charleston, S. C. have incorporated a railway company by this name.

Cheraw & Sumter.—A railway company by this name has been incorporated in South Carolina.

Rockville & Charleston.—It is reported that a railway will be built from Rockville, on Wadmalaw Island, to Charleston, S. C.

French Broad Valley.—Bids will be received until Jan. 21. for the grading, masonry, bridging, and crossties for this North Carolina railway. The road is to run from Asheville, N. C., via Little River and Brevar, to the South Carolina State line, a distance of 60 miles. C. G. DYOTT, 52 Wall St., New York city, is President.

Florida Midland & Gulf.—A construction company has been formed to build this road which is to run from Valdoster, Ga. to Madison, Fla., 36 miles.

West Virginia & Pennsylvania.—Contracts are reported let for this road, which is projected to run from Rowlesburg, W. Va., up the Cheat River to Fairchance, Pa. The route is through one of the best mineral sections of West Virginia. Work, it is stated, will commence in the spring.

Pittsburg & Virginia.—At a meeting of the stockholders recently held Ex-Governor FITZHUGH LEE, of Lexington, Va., was elected President. The company proposes to build a railway from Pittsburg, Pa., to Lexington, Va.

NORTHWEST.—Existing Roads.

Northern Pacific.—It is announced that work on the extension of the Jamestown & Northern R. R. from Leeds, No. Dak., north, early in the spring of 1890. The road runs through a fertile country from Leeds to Dunsuth, a distance of about 70 miles.

Port Arthur, Duluth & Western.—Surveys are in progress for a branch from the main line of this road to Kakabeka Falls, Ont.

Atchison, Topeka & Santa Fé.—A press dispatch from Carthage, Ill., says: The old talk about the Santa Fé railroad purchasing the Warsaw & Hamilton branch of the Toledo, Peoria & Western R. R., and extending it to Nauvoo and Quincy along the river has been revived, and the presence of railroad surveyors near Nauvoo tends to give color to the rumors. Parties in Warsaw claim to have reliable information to the effect that the the deal will be made.

Mt. Auburn & Taylorville.—A company has been partially organized to build a railway from Mt. Auburn to Taylorville, Ill. Among the projectors are J. B. MATHEWS, GEORGE PARRISH, and I. N. WARD, all of Taylorville.

Projects and Surveys.

Crookston, Fort Stevenson & Montana.—JNO. MCLEAN, of Crookston, Minn., President, sends us the following information concerning this enterprise:

This road is projected to run from Crookston, Minn., to the Red River of the North and thence to Ft. Stevenson, No. Dak., a distance of 200 miles. The surveys for the line will begin early in the spring. The route is through a prairie country affording easy grades and curves. There will be only one bridge of any importance across the Red River. About $25,000 of bonds have been subscribed by Crookston in aid of the enterprise. No other local aid has been secured. Contracts for construction will be let in the spring. It is expected that tracklaying will begin in the fall of 1890, and the road be completed Jan. 1, 1891.

SOUTHWEST.—Existing Roads.

Dallas, Pacific & Southeastern.—W. J. SHERMAN, of Dallas, Tex., Chief Engineer, has furnished us with the following information concerning this enterprise:

The road is projected to run from Dallas, Tex., northwest, via Grapevine, Roanoke, Rhone, and Aurora, Tex., towards Albuquerque, N. Mex., a distance of 625 miles. The work is about medium; maximum grade 1.2 per cent, and maximum curve 4°. The principal business of the road will be in minerals, timber, and agricultural produce. About 70 miles of the line has been graded and work is now in progress under the direction of the contractors, Burkett, Burns & Co., of Palestine, Tex. It is expected that tracklaying will begin about Feb. 1 and a portion of the road be opened for traffic by July 1. The company was incorporated Feb. 19, 1889.

Kansas City, Watkins & Gulf.—About 40 miles of this Louisiana road are graded ready for tracklaying. J. B. WATKINS, of Lawrence, Kan., is President.

Projects and Surveys.

Kansas & Missouri Terminal.—A correspondent writes us as follows concerning this enterprise:

The company has just been chartered. Its object is to reclaim about 185 acres of land from the encroachments of the Missouri River on the north side of Kansas City, Mo. This land when reclaimed will be very valuable, perhaps worth $200 per front foot. It is pro-

posed to build large railway terminals at a cost of about $1,500,000 to furnish terminal facilities for a number of lines entering the city now inadequately supplied.

Arkansas & Gulf.—The officers of this company, whose incorporation was noted in our last issue, are: President, B. W. BERGHOLTZ; Vice-President, J. F. O'SHAUGNESSY, Treasurer, C. H. ODELL, all of New York City, and Secretary, Wm. BONNER, of Kansas City, Mo. The road is to run from Pendleton, Ark., south to the Louisianna State line. Work, it is stated, will begin at once..

ROCKY MT. AND PACIFIC.—Existing Roads.

Wyoming, Salt Lake & California.—A recent issue of the *Salt Lake Tribune* contains the following description of this enterprise:

This road is a Salt Lake enterprise, and recent developments promise to make it a leading trunk line to the Pacific Coast. An excellent route has been secured, with good alignments and easy grades through Utah, Nevada, and California, and via valuable mineral districts held back for lack of railway facilities. The present eastern terminus is Evanston, beyond which it will be extended to connect with some system operating to Chicago. Coming from Evanston via Yellow Creek cañon, the road enters Utah at the southwest corner of Wyoming, and then follows Chalk Creek cañon to Coalville. Then the old roadbed of the Utah Eastern was secured to Park City, but at Parley's Park the main line diverges from it, and the remaining six miles to Park City will be operated as a branch line. From the junction the main line crosses to East cañon and passes under the summit of the mountain through a 600 foot tunnel, reaching this city via Emigration Cañon. * * *

The building of the Wyoming, Salt Lake & California Railway to the West means that a new impetus will be given to the Salt Lake smelting works, for hundreds of tons of ore will be shipped every day, and Salt Lake City will assume that position to Central Nevada that Denver has long held to Colorado, viz., as a base of supplies to the mining camps. In construction, while little stir has been made in this neighborhood, work has been actively pushed at the eastern end, forty miles are now ready for the rails, and before April the line will be ready for operation between Evanston and Park City. Beginning this month, work in the mountains will be pushed so that the tunnel work need not delay track laying, and the line west will be started and pushed so that by September the new railway ought to be operating between Evanston and Deep Creek with a new connection to the East.

Silver City, Pinos Altos & Mongallon.—The grading on this New Mexico road has been completed between Silver City and the Pacific mine in the Pinos Altos district. The rails have been purchased and track laying will begin on this section soon. Work is being pushed by the company, and it is expected that the line will be completed to the Mongallon country next fall.

Denver & Rio Grande.—Work on the rack railway to the summit of Pike's Peak is making good progress. About six miles of the road have already been graded, and work is in progress. It is the intention of the company to commence tracklaying in April, and to have the road completed by July.

Projects and Surveys.

Rio Grande Southern.—C. W. GIBBS, of Silverton, Colo., Chief Engineer, writes us that the surveys for this road have been completed from Dallas to Telluride, Colo., 432 miles. The maximum grade from Dallas to Divide is 4 per cent., from Divide to Placerville, 3 per cent., and up the San Miguel River to Telluride, 2 per cent. The maximum curve is 20°. Construction will commence early in 1890.

San Diego.—Application has been made to the San Diego Trustees for a right of way for a railroad into and through San Diego, Cal. The applicants are WILLIAM BEARD of New York, and ELI MURRAY of San Diego. The road is to connect with two or more transcontinental lines, and work is to be commenced as soon as the request is granted.

Willamette & Calapooia.—Chartered in Oregon to build a line of railway from North Brownsville east, through the Calapooia Valley to the Blue River mines, or some other point on the headwaters of the Calapooia River. The line will also be extended west, from North Brownsville to some point on the Willamette River. The principal offices of the company will be at North Brownsville. Among the incorporators are: J. M. WATERS, C. D. DRAKE, and R. N. THOMPSON.

Escondido & Pacific Beach.—Surveys are reported in progress for a railway from Escondido to Pacific Beach, Cal. The citizens of Escondido have given a land subsidy in aid of the enterprise. It is thought that work will commence in a few weeks and be pushed rapidly to completion. The road is said to be in the interest of the Palm Water Co.

FOREIGN.

Mexico.—The following railway concessions have been granted by the Mexican Government: To Gen. FELIPE BERIOZA BOLAND SEBASTIAN CAMACHO to build a railway from Tula, via Pachuca and Eulancingo to Zacualtipan, with power to extend the line to Tampico or Tuxpan. The surveys must begin at once and the construction within one year. The road must be completed in four years. A concession to BENIGNO V. GARCIA for a railway connecting the Port Guaymas coal lands with the cities of Hermosillo, Guaymas, and Alamos.—SALVADOR MALO, of the City of Mexico, has taken over the concession known as the Fènelon concession for a railway from Oaxaca to Tehuantepec.

RAPID TRANSIT.

Electric Railways.—*Lowell, Mass.*—The Board of Aldermen has granted a franchise permitting the introduction of the electric system, with overhead wires, on East Merrmack St. and High St.

Newark, N. J.—The resolutions offered by Alderman KETCHAM at the last meeting of the Council, permitting the use of the Thomson-Houston or Sprague electric ystems by the Essex Passenger Ry. Co. and the Rapid Transit Co., have been printed and distributed.

Atlanta, Ga.—Mr. AARON HAAS, of the Union St. Ry. Co., is reported to be in favor of the storage battery system of the Union Car Mfg. Co., of Boston. This system is in operation on the line between Beverly and Danvers, Mass.

Sioux Falls, Dak.—The electric railway to East Sioux Falls, a distance of 6 miles, is now under construction and is expected to be in operation by February.

Salina, Kan.—The street railway is to be operated by electricity.

Argentine, Kan.—The Metropolitan St. Ry. Co., of Kansas City, will double-track the new electric line between Kansas City and Argentine.

Atchison, Kan.—The street railways have been purchased by a syndicate headed by JOHN WEBBER, of Des Moines, Ia., and an electric system will be introduced.

Pueblo, Col.—The Pueblo Rapid Transit Co. and Pueblo St. Ry. Co. have applied for power to adopt electric traction.

Denver, Col.—The Denver Tramway Co.'s electric line has been put in operation. The line is 4 miles long, and is operated on the Sprague system. The cars were built by the Woeber Bros. Car Co., of Denver. Mr. IRVING HALE is the electrician.

Missoula, Mont.—An electric railway is to be built to South Missoula.

San José, Cal.—A franchise for an electric railway has been granted to the San José & Santa Clara Ry. Co. The poles may be in the middle of the street or on the curb line.

Street Railways.—*Greenfield, Mass.*—A company is to be organized by New York and local capitalists to build a street railway from the railway station to the suspension bridge near Turner's Falls. SIDNEY DILLON and CLARK BELL, of New York; Mr. CUTTER, Mr. GUNN and F. E. WELLS, of Greenfield, are interested. Capital stock, $30,000.

Elizabeth, N. J.—The Elizabeth St. Ry. Co. is increasing the length of its turnouts and laying a double track from Madison Ave. to the Union station.

Indianapolis, Ind.—The Judson Pneumatic St. Ry. Co. is said to have acquired a controlling interest in the Brightwood St. Ry. Co. The Judson Co. is preparing to put in its system on an experimental piece of line.

Oscoda, Mich.—A franchise for a street railway in and between Oscoda and AuSable has been granted to Haines Bros., of Kinderook, N. Y.

Streator, Ill.—The Streator Ry. Co. has been incorporated by DANIEL HERMAN, G. L. RICHARDS and MILTON HICKS. Capital stock, $250,000.

Denver, Col.—A franchise for a street railway has been applied for by PETER O'BRIEN, and others.

Tyler, Tex.—Materials have been ordered for the construction of a street railway 6¾ miles long.

Cable Railways.—*Pueblo, Col.*—The Pueblo St. Ry. Co. has had plans and specifications for a cable road prepared by Stearn, Rogers & Co. The city will be asked for a franchise.

Elevated Railways.—*Brooklyn, N. Y.*—The Union Elevated Ry. Co. proposes to build an extension of its 5th Ave. line from the present terminus at Greenwood Cemetery along 3d Ave. to Fort Hamilton. A commission has been appointed by the mayor to take evidence and decide upon the route.—Another commission has been appointed to consider the proposed line along Atlantic Ave. from South Ferry to the city line.—The Fulton Elevated Ry. Co., which is practically the same as the Kings County Elevated Ry. Co., proposes to build a cross-town road on Kent Ave.

Chicago, Ill.—The Chicago South Side Rapid Transit Ry. Co., whose line is known as the "Alley" elevated road, has commenced work on 25th St., between Wabash Ave. and State St. Mr. TUCKER is the Assistant Engineer, in charge of construction. Mr. E. G. Grabel has the contract for excavation.

HIGHWAYS.

Georgia.—All the roads of Bibb County are reported to be in excellent condition; there are now 220 miles of road in the county, 20 miles of which were built during 1889. The work is done by the chain gang. J. S. MCGEE, of Macon, is Superintendent.

Massachusetts.—The town of Milford has appropriated $6,840 for a new road.

Long Island.—The Board of Highway Commissioners of Huntington has made contracts with a number of the townsmen for working the highways.—The Flatbush Plank Road Co., incorporated in 1865, has been dissolved.

Maryland.—At a recent meeting at Towsontown a committee of one from each district was appointed to report at an adjourned meeting such amendments to the road law of Baltimore county as may be deemed necessary. The committee will make its report on Jan. 15. It has been suggested that, in view of the large annual expenditure in Baltimore County, which scarcely has any appreciable effect in bettering the condition of the roads, it might be more economical to capitalize this sum by issuing bonds, and with the funds thus secured to put the roads in such thorough order that the object sought would be accomplished at once, and the cost of repairs be reduced to a minimum.

Texas.—The following notes are from Texas local papers: Through both the city and country press the people of Texas are clamoring for good roads. They are beginning to realize that good wagon roads are of more importance to the country than more railways, and that money spent to secure them is money wisely expended.—Hamilton has supplied herself pretty well with bridges, and needs a more thorough system of road working. Good public roads mean great prosperity.—Texas will never have any better roads with the present farce of a road law. A sensible law should be the first thing to work for, and then we can have some hope of getting good roads.—Good roads improve the value of property, so that it is said a farm lying five miles from market, connected by a bad road, is of less value than an equally good farm ten miles away from market, connected by a good road. Good roads promote the advancement of country and town, and country and town should unite to have them.

CONTRACTING.

Turbine.—The following proposals for a turbine wheel and centrifugal pump for draining the new Croton gatehouse, on Section 1 of the new Croton aqueduct, have been received by the Aqueduct Commissioners, New York: Joseph Edwards & Co., $2,135; Ames Iron Works, $2,280; Holyoke Machine Co., for turbine wheel only, exclusive of centrifugal pump, and placing of same, $900. The contract has been awarded to Joseph Edwards & Co.

Sewers.—*New Rochelle, N. Y.*—The following proposals for the construction of sewers and drains were received by H. T. VULTE, Secretary of the Commissioners of Sewers and Drainage, Dec. 17, 1889. The contract will probably be awarded to the lowest bidder. Mr. HORACE CROSBY is the Engineer of Sewers.

Bidders.	24-in. pipe	18-in. pipe	15-in. pipe	10-in. pipe	8-in. pipe	6-in. pipe	5-in. house connections	Rock from trenches	Manholes	Flushtanks	Lamp-holes	Totals
	$	$	$	$	$	$	$	$	$	$	$	$
J. H. Edwards, New York City	2.00	1.81	1.59	1.10	0.87	0.80	0.55	3.95	50	115	22	113,166.37
R. Dooley, New Rochelle	2.04	1.87	1.77	1.65	1.55	1.40	1.40	3.75	40	50	35	125,907.14
M. J. Leahy, New York City	3.00	2.00	2.00	2.00	1.25	1.00	0.40	2.50	40	80	9	90,826.00
Fogg & Scribner, New York City	2.25	1.75	1.50	0.95	0.87	0.78	0.52	2.75	45	90	18	118,924.60
Molloy Bros., New Rochelle	2.40	1.95	1.80	1.20	1.10	0.92	0.65	3.87	60	80	16	127,861.92

Sewers and Street Work.—*Washington, D. C.*—The following proposals for the construction of 4,340 ft. of brick sewers have been received by the District Commissioners: M. F. Talty, on all, $4.87; Andrew Gleeson, 2,000 ft. on 18th St., $5.39; 2,000 ft., on Rhode Island Ave., $5.51. W. H. Moore, 1st. St., $4.90; on Rhode Island. Ave. between 7th and 10th Sts., $4.95; on 18th St. between C. St. and Pennsylvania Ave., $5.25. B. J. Coyle, on all, $4.78.

Richmond, Va.—The Committee on Streets has awarded contracts as follows: New brick paving, to A. L. Phillips, at 67 cts. per sq. yd. Relaying brick paving, to Goodwin & Allport, at 18½ cts. per sq. yd. Sewer stones, to J. C. Mitchell, at $17.50. Gravel, to A. L. Phillips, at 45 cts per cart load. Paving alley between Laurel and Cherry Sts., at 93 cts. per sq. yd. Old stone paving, to John A. Weimbrum, at 31 cts. per sq. yd. Sewer-pipe, to West & Branch, at 66⅔ cts. discount on regular rates when taken by the car-load.

South St. Paul, Minn.—The bid of W. G. Mulligan grading Bircher Avenue was accepted. The bid was for 13 cts. per cu. yd. for earthwork, $18 per 1,000 ft. B. M. for lumber, and $1.40 per yd. for stone gutters.

Toronto, Ont.—The Board of Works has awarded contracts as follows: Peter Arnott and A. E. Hagerman for sawn lumber at $12.65 per 1,000 ft., and for cedar scantling for sleepers at $13.50 per 1,000 ft., C. L. Van Vlack for supplying cedar blocks at $5.95 per cord. For land stone to A. W. Godson for 300 toise at $10.90 per toise; James Hilts 25 toise at $10. John J. Booth secured the contract

for the sewer on Givens St. for $3,595, and Dunham St. sewer for $3,995 also for laying private drains east of Yonge St., 6-in. pipe per yd., $1.45; 9-in. $1.85; 12-in., $2.20. A. J. Browne, for private drains west of Yonge St. 6-in., $1.70; 9-in. $2.10; 12-in. $2.55. J. J. W. Unitt, spikes and 3-in. nails per 100 lbs. for $10.44.
Add to "Cement"

Dredging.—The following proposals have been received at the U. S. Engineer Office, Washington, D. C. for dredging in the Virginia channel of the Potomac River. The estimated amount of the work is 75,000 cu. yds. D. A. McConville offered to do the work for 25 cts. per cu. yd. making a total of $18,750. He will commence March 1, 1890; will do 30,000 cu. yds. monthly and complete the work by June 30, 1890. Thos. P. Morgan offered to do the work for 24 cts. per cu. yd., making $18,000 as the total. He will likewise commence on March 1, 1890; will do 22,000 cu. yds. per month and will be through by June 30, 1890.

Cement.—The following proposals have been received by the Docks Commissioners, New York City, for 500 bbls. of quick-setting Portland cement: Sinclair & Babson, $2.30 per bbl.; James Brand, $2.40; Dickinson Bros. & King, $2.42; Marcial & Co., $2.50; E. W. Fisher, $2.55. The contract was awarded to Sinclair & Babson.

The following is a corrected list of the bids received by B. R. GREEN, Engineer, Washington, D. C., for natural hydraulic cement for the Congressional Library building: Union Akron Cement Co., Buffalo, N. Y., $1.34 in barrels, $1.18 in bags. J. G. & J. M. Waters, Washington, $1.04 and 90 cts. Cumberland Hydraulic Cement & Mfg. Co., Cumberland, Md., $1.01½, 85 cts. These bids were all rejected and new bids advertised for on Jan. 4, for the reason that the samples accompanying the two lower bids failed to satisfactorily fulfill the requirements of the specifications and that the other bid was higher than a suitable cement can be procured for in this market.

Plaster Models.—The contract for plaster models for the Congressional Library building at Washington has been awarded by B. R. GREEN, Engineer and Superintendent, to Louis Anatois, of Washington, at $682 for originals and $190 for duplicates.

PROPOSALS OPEN.

Brick.—Furnishing about 750,000 paving brick. The DISTRICT COMMISSIONERS, Washington, D. C. Jan. 13.

Gas Lighting.—Gas or gasoline lamps. T. H. BAIN, City Clerk, Goldsboro, N. C. Jan 15.

Pump.—Pit pump for the low service tunnel at the Chain of Rocks. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. Jan. 21.

Cement.—About 12,000 bbls. of natural hydraulic cement. BERNARD R. GREEN, Superintendent and Engineer of Congressional Library Building, 145 E. Capitol St., Washington, D. C. Jan. 21.

Pipe and Hydrants and Pumping Plant.—Furnishing and laying water mains; furnishing stop-cocks, hydrants, wooden hydrant boxes, cast-iron stop-cock boxes, tapping cocks, tapping cock boxes, and manhole heads. Building pumping engine and boilers. The COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. Jan. 21.

Sewers and Street Work.—Sewers; grading, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. Jan. 21.

Bridge.—Across Grand River in Eagle County, Col. No bid to exceed $5,300 for substructure, superstructure and approaches complete. J. P. MAXWELL, State Engineer, Denver, Col. Jan. 20.

Sewers.—HENRY HESTERBERG, President, Street and Sewer Commissioners, Flatbush, N. Y. Jan. 21.

Bridge.—Substructure and superstructure of an iron draw-bridge over Warren River at N. Main St. DANIEL L. TUCKER, Secretary of the Bridge Committee, Warren, R. I. Jan. 25.

Iron Work.—Furnishing and delivering at site of Massachusetts State House extension, Boston, Mass., iron beams, plates, girders, columns and other iron, and for work thereon in accordance with drawings and specifications, copies of which and any additional information relating thereto may be had on application at the office of BRIGHAM & SPOFFORD, Architects. THE STATE HOUSE CONSTRUCTION COMMITTEE, 27 Mt. Vernon St., Boston, Mass., Jan. 28.

Building.—Construction of the Stevens Library. THE LIBRARY BUILDING COMMITTEE, Ashburnham, Mass. Feb. 15.

MANUFACTURING AND TECHNICAL.

Metal Market Prices.—*Rails.*—New York: $35, Pittsburg: $35 to $36; old rails, $24 for steel, $28 for iron. Chicago: $37.50; old rails, $20.50 to $21.25 for steel, $26 for iron.

Track Material.—Pittsburg: spikes, $2.15, or $2.25 at Chicago and St. Louis; splice bars, 2 to 2.10 cts.; track bolts, 3.10 cts. with square and 3.20 cts. with hexagon nuts. Chicago: spikes, 2.25 to 2.30 cts.; angle bars, 2 to 2.10 cts. for iron, 2.25 for steel; track bolts, 3 cts. with square and 3.15 cts. with hexagon nuts.

Pipe.—Wrought-iron; discounts as follows: butt-welded black, 50 per cent.; lap-welded black, 62½ per cent. butt-welded galvanized, 42½ per cent.; lap-welded galvanized, 50 per cent. Boiler tubes, 50 to 55 per cent. Cast-iron: prices range from about $27 to $30 per ton according to size of contract and competition.

Lead.—New York: 3.85 to 3.90 cts. St. Louis: 3.60 to 3.65 cts. Chicago: 3.65 to 3.70.

Material Wanted.—Rails, narrow gauge engine and rolling stock. J. A. Frazier, Alum Springs, Va.

About 15 tons of 16-lb. rails. W. A. Bradford, Charleston, W. Va.

Rails and cars. J. P. Douglas, Tyler, Tex.

Wrought-iron drive pipe, 1,000 ft. of 12-in., and well casing. Z. P. Dederick, Sherman, Tex.

About 1,000 white oak piles, 20 to 40 ft. L. P. & J. A Smith, 1 Front St., Cleveland, O.

Plant for Sale.—The Oregon Paving & Contract Co. will sell its plant and quarry, with crusher, etc. DAVID STEEL, Secretary, 169½ 2d St., Portland, Ore.

Filters.—The National Water Purifying Co. has closed contracts with the American Glucose Co., Buffalo, N. Y., and the Morse Wool Scouring Co., of St. Louis, Mo., for National filter plants.

The Ball Engine Co. of Erie, Pa., reports shipment of engines to thirty-six different purchaser during the month of December. The aggregate horse-power of this output was 3,240 H. P. They also report that after Jan. 1, 1890, Mr. W. B. PEARSON will represent this company at 403 Home Insurance Building, Chicago.

Signals.—The Mills Interlocking Switch & Signal Co. has been incorporated at Chicago by F. J. HOYT, MILTON WESTON, and M. B. MILLS. Capital stock, $1,000,000.—The Automatic Railway Signal Co., of Des Moines, Ia., has been incorporated by J. A. T. HULL, W. D. LUCAS, W. S. DUNGAN, A. J. BAKER, B. B. TAYLOR, E. J. FAIRALL, R. M. DEWITT, and B. R. SPRY, to manufacture a device invented by D. M. FIKE, of Des Moines. Capital stock, $1,000,000.

Ties.—The Union Tie & Timber Co. has been incorporated at Chicago by A. E. FORREST, H. W. BLEND, and F. T. ROBINSON. Capital stock, $10,000.

A Wrecking Frog has been invented by Superintendent O. M. DUNN and Master Mechanic J. V. SLUSSER, of the Louisville & Nashville R. R. It has a transverse flange rail, secured to a bar of iron or steel, which is raised to an exact level with the rail, so that a derailed car is placed on the rail without any "jump or jar, and the prospect of jumping off on the other side is reduced to a minimum. It weighs 100 lbs. and has been used on the Louisville & Nashville and Little Rock & Memphis roads.

Cement.—A deposit of cement rock at Trinidad, Col., is to be developed by an eastern company.—The Fort Worth Cement Co., of Fort Worth, Tex., has been incorporated by J. W. WILLIAMSON, S. G. RINTLEMAN and others, to build cement works.—The Jackson & Jones Co. has been organized by ELIHU E. JACKSON, of Salisbury, Md., and others, to establish lime and cement works.

Pipe.—At Montreal, P. Q., a company has been formed with headquarters at Three Rivers, for manufacturing on an extensive scale cast-iron water and gas pipes and general supplies in this particular line for construction purposes. It expects to be in full operation early this spring as the buildings are nearly completed.

The Pittsburg Reduction Co., manufacturers of aluminum, have ordered an increase of the plant, including three 250 H. P. Babcock & Wilcox boilers, two 250 H. P. compound Westinghouse engines, and two extra 125,000 watt dynamos from the U. S. Electric Lighting Co. A new iron building 70 ft. x 120 ft. is to be built. It is expected to have the additional plant in shape by April, when the output will be increased to more than six times what is now manufactured.

Ballast.—Broken stone is to be used on the Savannah, Griffin & North Alabama and Milledgeville & Eatonton railways. For particulars address Mr. C. E. MARVIN, Roadmaster, Savannah, Ga.

Locomotives.—The Rogers Locomotive Works, of Paterson, N. J., have delivered two ten-wheel engines to the Norfolk & Western.

The Litchfield Car & Machine Co., of Litchfield, Ill., is rebuilding several engines for the St. Louis & Chicago.

The superintendent of the locomotive department of the Pennsylvania company at Fort Wayne has received instructions to build ten new locomotives of the class "S" type. During the last six months these shops have built 5 engines of this class.

The Grant Locomotive Works have been incorporated at Chicago, Ill., by E. T. JEFFREY, GEO. M. BOGUE, and W. T. BLOCK. Capital stock, $800,000.

Cars.—The Centropolis Car & Machine Co., of Centropolis, Mo., has an order for several summer cars for the Metropolitan cable railway, of Kansas City.

The St. Charles Car Co., of St. Charles, Mo., has completed a number of passenger, mail, and baggage cars for the Rio Grande Western.

The Burton Stock Car Works, of Wichita, Kan., are building 42 stock cars for the Chicago, Rock Island & Pacific.

Fences.—The Wire, Metallic & Electric Fence Co. has been incorporated at Chicago by W. D. RINEHART, F. W. HAAS, and C. A. SCOTT. Capital stock, $500,000.

Brakes.—The Boyden Brake Co. of Baltimore, Md., for the manufacture and sale of brakes and their adjuncts for cars and locomotives, has been incorporated by GEORGE A. BOYDEN, DOUGLASS H. THOMAS, WILLIAM WHITRIDGE, CHARLES B. MANN, EDWIN F. ABELL, and SKIPWITH WILMER. The capital stock is $2,500,000.

Ryan & McDonald, of Waterloo, N. Y., report a heavy and increasing demand for contractors' plant. Large orders are in hand for cars and hoisting engines, and a few for contractors' locomotives. The demand for derrick fittings, winches, hoisting drums, etc., has also been heavy. The works are being operated to their full capacity, running 13 hours a day.

The Embudo Construction Co., of East St. Louis, Ill., has been incorporated by GEORGE MINCH, WM. ATCHISON and G. ELLIOTT to construct railways, reservoirs, irrigation canals, etc. Capital stock, $160,000.

Aluminum.—The Carroll Aluminum Mfg. Co. has been incorporated by C. CARROLL, of New York, W. H. DWINELLE and E. S. CARROLL. Capital stock, $1,000,000.

Track Signal.—J. D. BERRY, of Chester, S. C., a section-master on the Chester & Lenoir R. R., has invented a track signal to be used in place of flags. A trakeman sent back from a disabled train, etc., fixes the target to the end of a tie and can return to his train.

Bricks.—The Michigan Land Brick Co. has been incorporated at Chicago by E. H. LEWIS, R. B. BURHANS and C. W. GRIGGS. Capital stock, $60,000.

Car Doors.—The Economy Car Door Co. has been organized at East St. Louis, Ill., by J. C. WANDS, C. T. WESTLAKE and S. MIMSON. Capital stock $150,000.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*Atchison, Kan.*—The Atchison, Topeka & Santa Fé R. R. Co. has secured the charter for a bridge across the Missouri River at Atchison, Kan., granted some years ago to a syndicate of Kansas and Missouri capitalists, and will, it is stated, build a steel bridge at that point to cost $1,200,000. The work is to be completed by September, 1890.

Pittsburg, Pa.—Work is making rapid progress on the bridge across the Ohio River at Brunot's Island, which is being built by the Pennsylvania R. R. Co. Work is nearly completed on the piers and will be commenced soon upon the superstructure.

Dominion Bridge Co.—This company has just turned out from its works at Lachine a train of 28 cars loaded with new steel bridges for the Canadian Pacific Ry. It is also stated that this will shortly be followed by another train load for the same company. The Bridge company has also orders in hand for the Grand Narrows bridge, Nova Scotia, the Grand Trunk Ry., the Vaudreuil & Prescott Ry., Canada Atlantic R'y., Drummonds County Ry., and Quebec & Lake St. John Ry.

Cummins, Ark.—Plans are being prepared by Orlopp & Kussner, of Little Rock, Ark., for the bridge across the Arkansas River to be built by the Kansas City, Arkansas & New Orleans Ry. Co. The bridge will be 1,200 ft. long with a draw span of 380 ft.

Fort Smith, Ark.—It is stated that the Missouri Pacific Ry. Co. will commence work on its proposed railway wagon, and foot bridge across the Arkansas River at this point before Feb. 1.

Kansas City, Mo.—Work has been commenced on the superstructure of the Twelfth Street Viaduct by the contractors, the Kansas City Bridge & Iron Co

Cheyenne, Wyo.—The iron viaduct to be erected by the city over the tracks and buildings of the Union Pacific Ry. will be 1,055 ft. long. The total length including approaches will be 1,340 ft. It is to be completed before Jan. 1, 1891.

Middletown, Conn.—The Stewart Bridge Co., of Philadelphia, Pa., has made an offer to build a pontoon bridge connecting Middletown and Portland, Conn., for $18,000. The structure will be fitted with a draw.

Pendleton, Ark.—The Arkansas & Gulf R. R. Co. will procure a charter from Congress for a bridge across the Arkansas River at Pendleton. The bridge will cost $350,000.

Houston, Tex.—C. W. LEWIS, City Engineer, will receive proposals for the construction of a 250-ft. draw bridge at this city.

Plattsmouth, Neb.—ROBERT ENOCH, of Chicago, Ill., has made a proposition to the citizens of Plattsmouth, Neb., to erect a pontoon bridge across the Missouri River at that point. It will cost about $25,000.

Jackson, Ia.—The iron bridge across the Des Moines River at this place has been completed. The structure is 210 ft. long with a span of 120 ft. and 45 ft. approaches at each end.

St. Paul, Minn.—The contract for building the substructure of the Broadway Bridge has been let to Kirkland & Starkey, of St. Paul, for $86,594. Work is to be commenced at once.

Newark, N. J.—The iron work of the Clay Street bridge across the Passaic River is nearly completed. The

work of erecting the engine to operate the draw will begin soon. Nothing has yet been done upon the approaches.

Providence, R. I.—The New York, Providence & Boston R. R. proposes building a bridge across the Sukonk River at this place.

Philadelphia, Pa.—Work on the three bridges across the Schuylkill River between the Falls of Schuylkill and Manyaunk is making good progress. The stone work of the Baltimore & Ohio R. R. bridge is nearly completed and work on the superstructure will soon begin. Work has been delayed on the City Avenue bridge but is now making good progress on the foundations and approaches. The stone work is completed on the Philadelphia & Reading R. R. bridge.

Proposed.—Bridges are proposed at Marion, S. C. Stillwater, Minn., and St. Charles, Mo.

Kentucky Union R. R.—Work is making rapid progress on the bridge across the Kentucky River for this railway. The bridge consists of one 300-ft. span and two 100-ft. spans. One span of 100 ft. is completed and work is well advanced on the 300-ft span.

Toronto, Ont.—The City Engineer has submitted his report upon the cost of the proposed iron or steel bridge from the present Dundas St. bridge to Sorauren Ave. The cost of the work will be about $40,000, made up as follows: Cost of land, $10,000, cost of embankments, $2,000, cost of an iron and steel bridge, $28,000.

Bothwell, Ont.—A bridge to cost $24,000 is to be built at Bothwell, Ont. Address ROBERT BOSTON, Reeve of Lobo, Ont.

Clinton, Ia.—A bill has been introduced into Congress authorizing the construction of a bridge across the Mississippi River at this point.

Monono Co., Ia.—Congress will be asked for a charter to build a bridge across the Missouri River at some point in Monono Co., Ia.

Staten Island, N. Y.—The bridge across the Arthur Kill for the Baltimore & Ohio R. R. has been opened for traffic. The structure is 800 ft. long, with two fixed spans of 150 ft. each and a draw of 500 ft. The bottom of the draw is 30 ft. above high-water mark.

Grand Rapids, Wis.—The Grand Rapids Toll Bridge Co. has been incorporated to build a bridge at this place. B. G. CHANDOS and G. J. JACKSON, are among the incorporators.

Tunnels.—*Kentucky Union R. R.*—The 920-ft. tunnel for this road, located about 11 miles east of Clay City, Ky., is about one-third completed. Excavation is now progressing at the rate of 8 ft. per day.

ELECTRICAL.

Electric Lighting.—*Boston, Mass.*—The following bids have been received by GEO. H. ALLEN, Superintendent of Lamps: Suburban Light & Power Co., $30,74 for the city, West Roxbury, Dorchester, and South Boston districts, for a term of five years; $38.99, $38.99, and $37,99 for Roxbury for terms of one three or five years. Brookline Gas Co., 40 cts. per light per night for the Brighton district for five years. Walworth Light & Power Co., 40 cts. per light per night for the city, South Boston, East Boston, Roxbury, Dorchester, West Roxbury, Charlestown, and Brighton districts.

Blackstone, Mass.—It is proposed to light the town by electricity, and a special meeting has been held to consider the question.

Central Falls, R. I.—A number of the taxpayers are in favor of adopting electricity instead of gas for street lighting.

Troy, N. Y.—The Troy Electric Light Co. has leased for 50 years the plant of the Edison Electric Light Co., at the Union depot. The capacity of the Edison plant is 2,00) incandescent lights and 50 arc lights. The works at the depot will be operated by the Troy Electric Light Co. under the management of JAS. C. MINAHAN, and will not be connected with the circuits of the Troy Electric Light Co.

Scottdale, Pa.—An electric light company has been organized and a charter will be applied for. President, BURGESS PORTER; Secretary, N. S. LANE. Capital stock, $12,000.

Middlesborough, Ky.—The Middlesborough Electric Light, Heat & Power Co. has been incorporated by J. B. CARY, C. M. WOODBURY and A. A. ARTHUR. Capital stock, $250,000.

Columbus, Ga.—A contract has been made with the Columbus Electric Light Co. for the lighting of the entire city.

Ocala, Fla.—A contract for electric light plant has been let to the Thomson-Houston Co., of Boston. For particulars address J. O. CLARKE.

Alliance, O.—The City Council has awarded the contract for lighting the north side of the city with electricity to the Mutual Electric Light Company, representing the Western Electric Company and the south part to the Alliance Street Railway Company, representing the Thomson-Houston Company. The contract calls for 2,000 c. p. arc lights, to burn until midnight every night, at a rate of six dollars per light per month.

Urbana, O.—The City Council has contracted with the Western Electric Light Co. for 50 arc lights, of 2,000 c. p. each, for street lighting. The lights are to burn every night in the year, and the price paid is $85 per light, or $4,250. The contract is for five years, provided the light is satisfactory after a thorough test. This will be cheaper than the present gas lighting.

Detroit, Mich.—The council committee on public lighting will report next Tuesday evening in favor of awarding the contract for the next three years to the Detroit Electric Light & Power Co. at the rate of $115,825.45 a year. The tower system will be abolished within the half-mile circle, the business center to be lighted by poles with underground wires. The claim of the Brush Co. that it has a monopoly of the tower and lamp system, the aldermen feel should be tested, and this the Detroit Co. promises to do, indemnifying the city against a damage judgment in a bond of $50,000. There is said to be quite a strong feeling in favor of the city owning and operating a plant of its own.

Naperville, Ill.—The Naperville Electric Co. has been incorporated by H. E., C. C., and A. J. TRAVIS. Capital stock, $12,000.

St. Louis, Mo.—The sale of the United Electric Light & Power Co. to the St. Louis Illuminating Co. was completed Jan. 3, by the filing of two deeds, for $700,000 and $900,000.

Fort Worth, Tex.—A committee of the Board of Trade has visited several cities for the purpose of inspecting the electric light systems in use, with a view to the establishment of some system in Fort Worth.

SEWERAGE AND MUNICIPAL.

Sewers.—*Framingham, Mass.*—The selectmen have notified the Boston officials that the system of sewerage provided for Framingham has been completed and is in operation, and that all sewage is discharged outside of the drainage area of the Boston water supply. In this notice a demand is also made for the sum of $25,000, which Boston, through its water board, agreed to pay toward the cost of construction, provided the system was completed and in operation on or before Dec. 31. The system cost $101,235.

Narragansett, R. I.—Suit has been brought to restrain the town from building a sewer to discharge into Narrow River. Mr J. HERBERT SHEDD, one of the engineers examined, considered that the sewage would be a nuisance.

Jersey City, N. J.—A consultation has been held by the city officials and representatives of the Pennsylvania R. R. Co. in relation to the defective sewerage of the 3rd District, about which much complaint has been made. City Engineer RUGGLES declared that the only method to obtain relief is to establish a pumping station near the shore front to pump the sewage into the river. Engineer BLAU, who had been employed by the Citizens' Association, thought that a 5 ft. iron pipe laid through the railway property would afford the needed relief. The railway company owns all the property through which the sewer would be built, and would, if it petitions for the sewer, be assessed for nearly all the cost.

Clarksville, Tenn.—Plans for sewers are to be prepared by R. F. HARTFORD, of Chattanooga.

Brunswick, Ga.—A contract has been made for a sewerage system to be built on the West plan.

Mobile, Ala.—The Mobile Land & Con-truction Co. has been incorporated by Dr. GEO. A. KETCHUM, G. PALLEN, of St. Louis, Mo., O. F. CAWTHON, and others. Capital stock, $20,000. The company intends to build a system of sewers.

Waukesha, Wis.—The plans for a sewer system prepared for the village by Mr. GOODHUE, of Milwaukee, have been adopted by ordinance, and Feb. 3 has been fixed upon as the date of an election, when the question will be submitted to the people of issuing bonds to the amount of $30,000, the same to draw 5 per cent. interest and to mature in 30 years.

Denver, Col.—The City Engineer's plans for new sewers are said to involve an expenditure of $1,000,000.

Beatrice, Neb.—The $20,000 sewer bonds have been sold to W. J. Hayes & Sons, of Toledo, O.

Oakland, Cal.—Mr. HERING has presented a partial report of his proposed system of sewerage. It comprises four intercepting sewers to discharge into the estuary and a pumping works at West Oakland. His estimate of the cost is $879,000.

Street Work.—*Brooklyn, N. Y.*—Mayor CHAPIN has prepared a bill authorizing the issue of $1,000,000 in bonds during 1891 for carrying on the street improvement work.

Norfolk, Va.—The city will grade and curb several streets, and pave them with shells.

Moundsville, W. Va.—It is proposed to issue bonds for $20,000 for brick paving. Contractor ROSSER, of Bellaire, is figuring on the work.

Nashville, Tenn.—During the present year about $39,975 will be expended in granite paving.

Mobile, Ala.—On Dec. 30 a contract was made giving the Improved Wood Pavement Co., A. C. DANNER, President, the care of the streets and culverts of the city, for a term of five years, the contractor to lay 4,000 sq. yds. of wooden or of brick pavement per annum all for the sum of $31,000 per annum.

Gas.—The Empire Gas Lighting Co., of Huntington, L. I., is laying mains and building its works.—The Suburban Gas Co. has been incorporated at Chicago, by J. R. CUSTER, J. M. CAMERON, and J. A. GRIFFIN. Capital stock, $50,000.

Oakland, Cal.—Preparations are being made to take a vote on public improvements as follows:

Reclamation of the West Oakland marsh	$175,000
Deepening of Lake Merritt	175,000
Total for sanitary improvement	$350,000
Salt water pumping and distributing works	150,000
School purposes	175,000
Electric lighting	75,000
Total	$750,000

Water Power.—The Holyoke Water Power Co. will build a new dam across the Connecticut river at Holyoke, Mass. It will cost $750,000. Judge GIDEON, of Springfield, is president of the company.

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—The question of water supply for the villages on the shore front is being agitated. It is the most important question to come up at the next annual town meeting in March.

Somersworth and Rollinsford, N. H.—The directors of the Somersworth and Rollinsford Water Co. have appointed a committee to consider a basis of consolidation with the Berwick (Me.) Water Co.

Boston, Mass.—The City Treasurer has been directed to issue registered certificates of indebtedness for $100,000, at 3½ per cent. per annum, for extending the high service system of the Cochituate works. An order was also passed directing the fire commissioners to report on the cost and expediency of establishing a system of pipes in the business district, to be used in case of fire, water to be taken from the harbor and delivered at hydrants under pressure from a pumping station on the water front.

Taunton, Mass.—The Water Commissioners have announced that they will call on the city this year for an addition to the pumping plant. The driven well scheme has been abandoned, and no further experiments in this line will be made.

Newton, Mass.—At a recent meeting of both branches of the City Council (Newton and West Newton) orders were adopted authorizing the taking of land on Waban hill, a tract in the vicinity of Nahanton St., and land in Needham, for the purpose of increasing the water supply. Also authorizing the City Treasurer to pay $24,850 interest on water debt.

Waterbury, Conn.—A considerable amount of cast-iron pipe, with hydrants, valves, etc. will soon be wanted.

MIDDLE.

Binghamton, N. Y.—A new 12,000,000-gall. pumping engine, about 25 hydrants, 30 meters, and valves, will be needed this year.

Cohoes, N. Y.—An order has been passed by the City Council, providing for the drafting of a bill to be presented to the Legislature, authorizing the city to issue bonds for $30,000 for extensions and improvements.

Ellicottville, N. Y.—Subscriptions for $6,000 have been received for constructing works.

Brockport, N. Y.—Preliminary work is now being done. The works will be put in operation about Aug. 1. Bassett Bros., of Buffalo, N. Y., are the contractors The Brockport Water Co. has been formed. President C. M. HARRINGTON; Secretary, E. M. BASSETT; both of Buffalo.

Cattaraugus, N. Y.—A public meeting was to be held on Jan. 6, to discuss the feasibility of putting in a system of water-works.

Holly, N. Y.—We have received the following information from E. M. BASSETT:

The Holly Water-Works Co. has been organized. C. M. HARRINGTON, President; E. M. BASSETT, Secretary; both of Buffalo. Capital stock, $45,000. The city will pay $1,125 per annum. Preliminary work is now being done. The works will be put in operation about Aug. 1.

Liberty, N. Y.—GEO. A. COWAN, Stamford, N. Y. says, "Expect to build at Liberty in the spring."

Plainfield, N. J.—The bond of the Water-Works Co. signed by JAMES MOORE, Chief Engineer of the Central R. R. Co., CHARLES K. MOORE, and ex-Congressman JOHN KEAN, Jr., has been accepted by the Common Council. The contract has been signed by Mayor JOB MALE and the members of the Council. The work of driving wells to test the supply of water has already been begun.

Keyport, N. J.—The Commissioners have decided to supply the town with water, and an appropriation of $1,000 has been guaranteed for experimenting with different methods. Artesian wells will probably be introduced.

Freehold, N. J.—The Committee in reporting on the experimental artesian well, state that it has been entirely satisfactory in demonstrating that a supply of wholesome water, sufficient for all the necessities of the town can be obtained by this means. The estimated cost of the projected works is $30,000 to $40,000. The Commissioners are: Chairman, JAMES S. YARD; WILLIAM MC DERMOTT; CHARLES TRUEX; WILLIAM H. BUTCHER and W. B. DUBYEE.

for the sewer on Givens St. for $3,595, and Dunham St. sewer for $3,995 also for laying private drains east of Yonge St., 6-in. pipe per yd., $1,45; 9-in. $1,85; 12-in., $2,20. A. J. Browne, for private drains west of Yonge St. 6-in., $1.70; 9-in. $2.10; 12-in. $2,35. J. J. W. Unitt, spikes and 3-in. nails per 100 lbs. for $10.44.
Add to "Cement"

Dredging.—The following proposals have been received at the U. S. Engineer Office, Washington, D. C. for dredging in the Virginia channel of the Potomac River. The estimated amount of the work is 75,000 cu. yds. D. A. McConville offered to do the work for 25 cts. per cu. yd. making a total of $18,750. He will commence March 1, 1890; will do 20,000 cu. yds. monthly and complete the work by June 30, 1890. Thos. P. Morgan offered to do the work for 24 cts. per cu. yd., making $18,000 as the total. He will likewise commence on March 1, 1890; will do 22,000 cu. yds. per month and will be through by June 30, 1890.

Cement.—The following proposals have been received by the Docks Commissioners, New York City, for 500 bbls. of quick-setting Portland cement: Sinclair & Babson, $2.30 per bbl.; James Brand, $2.40; Dickinson Bros. & King, $2.42; Marcial & Co., $2.50; E. W. Fisher, $2.55. The contract was awarded to Sinclair & Babson.

The following is a corrected list of the bids received by B. R. GREEN, Engineer, Washington, D. C., for natural hydraulic cement for the Congressional Library building: Union Akron Cement Co., Buffalo, N. Y., $1.34 in barrels, $1.18 in bags. J. G. & J. M. Waters, Washington, $1.04 and 90 cts. Cumberland Hydraulic Cement & Mfg. Co., Cumberland, Md., $1.01½. 85 cts. These bids were all rejected and new bids advertised for on Jan. 4, for the reason that the samples accompanying the two lower bids failed to satisfactorily fulfill the requirements of the specifications and that the other bid was higher than a suitable cement can be procured for in this market.

Plaster Models.—The contract for plaster models for the Congressional Library building at Washington has been awarded by B. R. GREEN, Engineer and Superintendent, to Louis Anatois, of Washington, at $682 for originals and $190 for duplicates.

PROPOSALS OPEN.

Brick.—Furnishing about 750,000 paving brick. The DISTRICT COMMISSIONERS, Washington, D. C. Jan. 13.

Gas Lighting.—Gas or gasoline lamps. T. H. BAIN, City Clerk, Goldsboro, N. C. Jan 15.

Pump.—Pit pump for the low service tunnel at the Chain of Rocks. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. Jan. 21.

Cement.—About 15,000 bbls. of natural hydraulic cement. BERNARD R. GREEN, Superintendent and Engineer of Congressional Library Building, 145 E. Capitol St., Washington, D. C. Jan. 21.

Pipe and Hydrants and Pumping Plant.—Furnishing and laying water mains; furnishing stop-cocks, hydrants, wooden hydrant boxes, cast-iron stop-cock boxes, tapping cocks, tapping cock boxes, and manhole heads. Building pumping engine and boilers. The COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City, Jan. 21.

Sewers and Street Work.—Sewers; grading, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City, Jan. 21.

Bridge.—Across Grand River in Eagle County, Col. No bid to exceed $5,200 for substructure, superstructure and approaches complete. J. P. MAXWELL, State Engineer, Denver, Col. Jan. 20.

Sewers.—HENRY HESTERBERG, President, Street and Sewer Commissioners, Flatbush, N. Y. Jan. 21.

Bridge.—Substructure and superstructure of an iron draw-bridge over Warren River at N. Main St. DANIEL L. TUCKER, Secretary of the Bridge Committee, Warren, R. I. Jan. 25.

Iron Work.—Furnishing and delivering at site of Massachusetts State House extension, Boston, Mass., iron beams, plates, girders, columns and other iron, and for work thereon in accordance with drawings and specifications, copies of which and any additional information relating thereto may be had on application at the office of BEIGHAM & SPOFFORD, Architects. THE STATE HOUSE CONSTRUCTION COMMITTEE, 27 Mt. Vernon St., Boston, Mass., Jan. 28.

Building.—Construction of the Stevens Library. THE LIBRARY BUILDING COMMITTEE, Ashburnham, Mass. Feb. 15.

MANUFACTURING AND TECHNICAL.

Metal Market Prices.—***Rails.***—New York: $35, Pittsburg: $35 to $36; old rails, $24 for steel, $28 for iron, Chicago: $37.50; old rails, $20.50 to $21.25 for steel, $26 for iron.

Track Material.—Pittsburg: spikes, $2.15, or $2.25 at Chicago and St. Louis; splice bars, 2 to 2.10 cts.; track bolts, 3.10 cts. with square and 3.20 cts. with hexagon nuts, Chicago: spikes, 2.25 to 2.30 cts.; angle bars, 2 to 2.10 cts. for iron, 2.25 for steel; track bolts, 3 cts. with square and 3.15 cts. with hexagon nuts.

Pipe.—Wrought-iron; discounts as follows: butt-welded black, 50 per cent.; lap-welded black, 62½ per cent. butt-welded galvanized, 42½ per cent.; lap-welded galvanized, 50 per cent. Boiler tubes, 50 to 55 per cent. Cast-iron: prices range from about $27 to $30 per ton according to size of contract and competition.

Lead.—New York: 3.85 to 3.90 cts. St. Louis: 3.60 to 3.65 cts. Chicago: 3.65 to 3.70.

Material Wanted.—Rails, narrow gauge engine and rolling stock. J. A. Frazier, Alum Springs, Va.

About 15 tons of 16-lb. rails. W. A. Bradford, Charleston, W. Va.

Rails and cars. J. P. Douglas, Tyler, Tex.

Wrought-iron drive pipe, 1,000 ft. of 12-in., and well casing. Z. P. Dederick, Sherman, Tex.

About 1,000 white oak piles, 20 to 40 ft. L. P. & J. A Smith, 1 Front St., Cleveland, O.

Plant for Sale.—The Oregon Paving & Contract Co. will sell its plant and quarry, with crusher, etc. DAVID STEEL, Secretary, 169½ 2d St., Portland, Ore.

Filters.—The National Water Purifying Co. has closed contracts with the American Gluscose Co., Buffalo, N. Y., and the Morse Wool Scouring Co., of St. Louis, Mo., for National filter plants.

The Ball Engine Co. of Erie, Pa., reports shipment of engines to thirty-six different purchaser during the month of December. The aggregate horse-power of this output was 3,240 H. P. They also report that after Jan. 1, 1890, Mr. W. B. PEARSON will represent this company at 403 Home Insurance Building, Chicago.

Signals.—The Mills Interlocking Switch & Signal Co. has been incorporated at Chicago by F. J. HOYT, MILTON WESTON, and M. B. MILLS. Capital stock, $1,000,000.—The Automatic Railway Signal Co., of Des Moines, Ia., has been incorporated by J. A. T. HULL, W. D. LUCAS, W. S. DUNGAN, A. J. BAKER, B. B. TAYLOR, E. J. FAIRALL, R. M. DEWITT, and B. R. SPRY, to manufacture a device invented by D. M. FIKE, of Des Moines. Capital stock, $1,000,000.

Ties.—The Union Tie & Timber Co. has been incorporated at Chicago by A. E. FORREST, H. W. BLEND, and F. T. ROBINSON. Capital stock, $10,000.

A Wrecking Frog has been invented by Superintendent O. M. DUNN and Master Mechanic J. V. SLUSSER, of the Louisville & Nashville R. R. It has a transverse flange rail, secured to a bar of iron or steel, which is raised to an exact level with the rail, so that a derailed car is placed on the rail without any jump or jar, and the prospect of jumping off on the other side is reduced to a minimum. It weighs 100 lbs. and has been used on the Louisville & Nashville and Little Rock & Memphis roads.

Cement.—A deposit of cement rock at Trinidad, Col., is to be developed by an eastern company.—The Fort Worth Cement Co., of Fort Worth, Tex., has been incorporated by J. W. WILLIAMSON, S. G. RINTLEMAN and others, to build cement works.—The Jackson & Jones Co. has been organized by ELIHU E. JACKSON, of Salisbury, Md., and others, to establish lime and cement works.

Pipe.—At Montreal, P. Q., a company has been formed with headquarters at Three Rivers, for manufacturing on an extensive scale cast-iron water and gas pipes and general supplies in this particular line for construction purposes. It expects to be in full operation early this spring as the buildings are nearly completed.

The Pittsburg Reduction Co., manufacturers of aluminum, have ordered an increase of the plant, including three 250 H. P. Babcock & Wilcox boilers, two 250 H. P. compound Westinghouse engines, and two extra 125,000 watt dynamos from the U. S. Electric Lighting Co. A new iron building 70 ft. x 120 ft. is to be built. It is expected to have the additional plant in shape by April, when the output will be increased to more than six times what is now manufactured.

Ballast.—Broken stone is to be used on the Savannah, Griffin & North Alabama and Milledgeville & Eatonton railways. For particulars address Mr. C. E. MARVIN, Roadmaster, Savannah, Ga.

Locomotives.—The Rogers Locomotive Works, of Paterson, N. J., have delivered two ten-wheel engines to the Norfolk & Western.

The Litchfield Car & Machine Co., of Litchfield, Ill., is rebuilding several engines for the St. Louis & Chicago.

The superintendent of the locomotive department of the Pennsylvania company at Fort Wayne has received instructions to build ten new locomotives of the class "S" type. During the last six months these shops have built 5 engines of this class.

The Grant Locomotive Works have been incorporated at Chicago, Ill., by E. T. JEFFREY, GEO. M. BOGUE, and W. T. BLOCK. Capital stock, $800,000.

Cars.—The Centropolis Car & Machine Co., of Centropolis, Mo., has an order for several summer cars for the Metropolitan cable railway, of Kansas City.

The St. Charles Car Co., of St. Charles, Mo., has completed a number of passenger, mail, and baggage cars for the Rio Grande Western.

The Burton Stock Car Works, of Wichita, Kan., are building 42 stock cars for the Chicago, Rock Island & Pacific.

Fences.—The Wire, Metallic & Electric Fence Co. has been incorporated at Chicago by W. D. RINEHART, F. W. HAAS, and C. A. SCOTT. Capital stock, $500,000.

Brakes.—The Boyden Brake Co. of Baltimore, Md., for the manufacture and sale of brakes and their adjuncts for cars and locomotives, has been incorporated by GEORGE A. BOYDEN, DOUGLASS H. THOMAS, WILLIAM WHITRIDGE, CHARLES B. MANN, EDWIN F. ABELL, and SKIPWITH WILMER. The capital stock is $2,500,000.

Ryan & McDonald, of Waterloo, N. Y., report a heavy and increasing demand for contractors' plant. Large orders are in hand for cars and hoisting engines, and a few for contractors' locomotives. The demand for derrick fittings, winches, hoisting drums, etc., has also been heavy. The works are being operated to their full capacity, running 13 hours a day.

The Embudo Construction Co., of East St. Louis Ill., has been incorporated by GEORGE MINCH, WM. ATCHISON and G. ELLIOTT to construct railways, reservoirs, irrigation canals, etc. Capital stock, $160,000.

Aluminum.—The Carroll Aluminum Mfg. Co. has been incorporated by C. CARROLL, of New York, W. H. DWINELLE and E. S. CARROLL. Capital stock, $1,000,000.

Track Signal.—J. D. BERRY, of Chester, S. C., a section-master on the Chester & Lenoir R. R., has invented a track signal to be used in place of flags. A trakeman sent back from a disabled train, etc. fixes the target to the end of a tie and can return to his train.

Bricks.—The Michigan Land Brick Co. has been incorporated at Chicago by E. H. LEWIS, R. B. BURHANS and C. W. GRIGGS. Capital stock, $60,000.

Car Doors.—The Economy Car Door Co. has been organized at East St. Louis, Ill., by J. C. WANDS, C. T. WESTLAKE and S. MIMSON. Capital stock $150,000.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—***Atchison, Kan.***—The Atchison, Topeka & Santa Fé R. R. Co. has secured the charter for a bridge across the Missouri River at Atchison, Kan., granted some years ago to a syndicate of Kansas and Missouri capitalists, and will, it is stated, build a steel bridge at that point to cost $1,200,000. The work is to be completed by September, 1890.

Pittsburg, Pa.—Work is making rapid progress on the bridge across the Ohio River at Brunot's Island, which is being built by the Pennsylvania R. R. Co. Work is nearly completed on the piers and will be commenced soon upon the superstructure.

Dominion Bridge Co.—This company has just turned out from its works at Lachine a train of 28 cars loaded with new steel bridges for the Canadian Pacific Ry. It is also stated that this will shortly be followed by another train load for the same company. The Bridge company has also orders in hand for the Grand Narrows bridge, Nova Scotia, the Grand Trunk Ry., the Vaudreuil & Prescott Ry., Canada Atlantic Ry., Drummonds County Ry., and Quebec & Lake St. John Ry.

Cummins, Ark.—Plans are being prepared by Orlopp & Kussner, of Little Rock, Ark., for the bridge across the Arkansas River to be built by the Kansas City, Arkansas & New Orleans Ry. Co. The bridge will be 1,200 ft. long with a draw span of 380 ft.

Fort Smith, Ark.—It is stated that the Missouri Pacific Ry. Co. will commence work on its proposed railway wagon, and foot bridge across the Arkansas River at this point before Feb. 1.

Kansas City, Mo.—Work has been commenced on the superstructure of the Twelfth Street Viaduct by the contractors, the Kansas City Bridge & Iron Co.

Cheyenne, Wyo.—The iron viaduct to be erected by the city over the tracks and buildings of the Union Pacific Ry. will be 1,055 ft. long. The total length including approaches will be 1,340 ft. It is to be completed before Jan. 1, 1891.

Middletown, Conn.—The Stewart Bridge Co., of Philadelphia, Pa., has made an offer to build a pontoon bridge connecting Middletown and Portland, Conn., for $18,000. The structure will be fitted with a draw.

Pendleton, Ark.—The Arkansas & Gulf R. R. Co. will procure a charter from Congress for a bridge across the Arkansas River at Pendleton. The bridge will cost $350,000.

Houston, Tex.—C. W. LEWIS, City Engineer, will receive proposals for the construction of a 250-ft. draw bridge at this city.

Plattsmouth, Neb.—ROBERT ENOCH, of Chicago, Ill., has made a proposition to the citizens of Plattsmouth, Neb., to erect a pontoon bridge across the Missouri River at that point. It will cost about $25,000.

Jackson, Ia.—The iron bridge across the Des Moines River at this place has been completed. The structure is 210 ft. long with a span of 120 ft. and 45 ft. approaches at each end.

St. Paul, Minn.—The contract for building the substructure of the Broadway Bridge has been let to Kirkland & Starkey, of St. Paul, for $86,594. Work is to be commenced at once.

Newark, N. J.—The iron work of the Clay Street bridge across the Passaic River is nearly completed. The

work of erecting the engine to operate the draw will begin soon. Nothing has yet been done upon the approaches.

Providence, R. I.—The New York, Providence & Boston R. R. proposes building a bridge across the Sukonk River at this place.

Philadelphia, Pa.—Work on the three bridges across the Schuylkill River between the Falls of Schuylkill and Manyaunk is making good progress. The stone work of the Baltimore & Ohio R. R. bridge is nearly completed and work on the superstructure will soon begin. Work has been delayed on the City Avenue bridge but is now making good progress on the foundations and approaches. The stone work is completed on the Philadelphia & Reading R. R. bridge.

Proposed,—Bridges are proposed at Marion, S. C. Stillwater, Minn., and St. Charles, Mo.

Kentucky Union R. R.—Work is making rapid progress on the bridge across the Kentucky River for this railway. The bridge consists of one 300-ft. span and two 100-ft. spans. One span of 100 ft. is completed and work is well advanced on the 300-ft span.

Toronto, Ont.—The City Engineer has submitted his report upon the cost of the proposed iron or steel bridge from the present Dundas St. bridge to Sornuren Ave. The cost of the work will be about $40,000, made up as follows: Cost of land, $10,000, cost of embankments, $2,000, cost of an iron and steel bridge, $28,000.

Bothwell, Ont.—A bridge to cost $24,000 is to be built at Bothwell, Ont. Address ROBERT BOSTON, Reeve of Lobo, Ont.

Clinton, Ia.—A bill has been introduced into Congress authorizing the construction of a bridge across the Mississippi River at this point.

Monono Co., Ia.—Congress will be asked for a charter to build a bridge across the Missouri River at some point in Monono Co., Ia.

Staten Island, N. Y.—The bridge across the Arthur Kill for the Baltimore & Ohio R. R. has been opened for traffic. The structure is 800 ft. long, with two fixed spans of 150 ft. each and a draw of 500 ft. The bottom of the draw is 30 ft. above high-water mark.

Grand Rapids, Wis.—The Grand Rapids Toll Bridge Co. has been incorporated to build a bridge at this place. B. G. CHANDOS and G. J. JACKSON, are among the incorporators.

Tunnels.—***Kentucky Union R. R.***—The 920-ft. tunnel for this road, located about 11 miles east of Clay City, Ky., is about one-third completed. Excavation is now progressing at the rate of 8 ft. per day.

ELECTRICAL.

Electric Lighting.—***Boston, Mass.***—The following bids have been received by GEO. H. ALLEN, Superintendent of Lamps: Suburban Light & Power Co., $39,74 for the city, West Roxbury, Dorchester, and South Boston districts, for a term of five years; $38.99, $38.99, and $37.99 for Roxbury for terms of one three or five years. Brookline Gas Co., 40 cts. per light per night for the Brighton district for five years. Walworth Light & Power Co., 40 cts. per light per night for the city, South Boston, East Boston, Roxbury, Dorchester, West Roxbury, Charlestown, and Brighton districts.

Blackstone, Mass.—It is proposed to light the town by electricity, and a special meeting has been held to consider the question.

Central Falls, R. I.—A number of the taxpayers are in favor of adopting electricity instead of gas for street lighting.

Troy, N. Y.—The Troy Electric Light Co. has leased for 50 years the plant of the Edison Electric Light Co., at the Union depot. The capacity of the Edison plant is 2,000 incandescent lights and 50 arc lights. The works at the depot will be operated by the Troy Electric Light Co. under the management of JAS. C. MINAHAN, and will not be connected with the circuits of the Troy Electric Light Co.

Scottdale, Pa.—An electric light company has been organized and a charter will be applied for. President, BURGESS PORTER; Secretary, N. S. LANE. Capital stock, $12,000.

Middlesborough, Ky.—The Middlesborough Electric Light, Heat & Power Co. has been incorporated by J. B. CARY, C. M. WOODBURY and A. A. ARTHUR. Capital stock, $250,000.

Columbus, Ga.—A contract has been made with the Columbus Electric Light Co. for the lighting of the entire city.

Ocala, Fla.—A contract for electric light plant has been let to the Thomson-Houston Co., of Boston. For particulars address J. O. CLARKE.

Alliance, O.—The City Council has awarded the contract for lighting the north side of the city with electricity to the Mutual Electric Light Company, representing the Western Electric Company and the south part to the Alliance Street Railway Company, representing the Thomson-Houston Company. The contract calls for 2,000 c. p. arc lights, to burn until midnight every night, at a rate of six dollars per light per month.

Urbana, O.—The City Council has contracted with the Western Electric Light Co. for 50 arc lights, of 2,000 c. p. each, for street lighting. The lights are to burn every night in the year, and the price paid is $85 per light, or $4,250. The contract is for five years, provided the light is satisfactory after a thorough test. This will be cheaper than the present gas lighting.

Detroit, Mich.—The council committee on public lighting will report next Tuesday evening in favor of awarding the contract for the next three years to the Detroit Electric Light & Power Co. at the rate of $115,825.45 a year. The tower system will be abolished within the half-mile circle, the business center to be lighted by poles with underground wires. The claim of the Brush Co. that it has a monopoly of the tower and lamp system, the aldermen feel should be tested, and this the Detroit Co. promises to do, indemnifying the city against a damage judgment in a bond of $50,000. There is said to be quite a strong feeling in favor of the city owning and operating a plant of its own.

Naperville, Ill.—The Naperville Electric Co. has been incorporated by R. E., C. C., and A. J. TRAVIS. Capital stock, $12,000.

St. Louis, Mo.—The sale of the United Electric Light & Power Co. to the St. Louis Illuminating Co. was completed Jan. 3, by the filing of two deeds, for $700,000 and $900,000.

Fort Worth, Tex.—A committee of the Board of Trade has visited several cities for the purpose of inspecting the electric light systems in use, with a view to the establishment of some system in Fort Worth.

SEWERAGE AND MUNICIPAL.

Sewers.—***Framingham, Mass.***—The selectmen have notified the Boston officials that the system of sewerage provided for Framingham has been completed and is in operation, and that all sewage is discharged outside of the drainage area of the Boston water supply. In this notice a demand is also made for the sum of $25,000, which Boston, through its water board, agreed to pay toward the cost of construction, provided the system was completed and in operation on or before Dec. 31. The system cost $101,235.

Narragansett, R. I.—Suit has been brought to restrain the town from building a sewer to discharge into Narrow River. Mr J. HERBERT SHEDD, one of the engineers examined, considered that the sewage would be a nuisance.

Jersey City, N. J.—A consultation has been held by the city officials and representatives of the Pennsylvania R. R. Co. in relation to the defective sewerage of the 3rd District, about which much complaint has been made. City Engineer RUGGLES declared that the only method to obtain relief is to establish a pumping station near the shore front to pump the sewage into the river. Engineer BLAU, who had been employed by the Citizens' Association, thought that a 5 ft. iron pipe laid through the railway property would afford the needed relief. The railway company owns all the property through which the sewer would be built, and would, if it petitions for the sewer, be assessed for nearly all the cost.

Clarksville, Tenn.—Plans for sewers are to be prepared by R. F. HARTFORD, of Chattanooga.

Brunswick, Ga.—A contract has been made for a sewerage system to be built on the West plan.

Mobile, Ala.—The Mobile Land & Construction Co. has been incorporated by Dr. GEO. A. KETCHUM, G. PALLEN, of St. Louis, Mo., O. F. CAWTHON, and others. Capital stock, $20,000. The company intends to build a system of sewers.

Waukesha, Wis.—The plans for a sewer system prepared for the village by Mr. GOODHUE, of Milwaukee, have been adopted by ordinance, and Feb. 3 has been fixed upon as the date of an election, when the question will be submitted to the people of issuing bonds to the amount of $30,000, the same to draw 5 per cent. interest and to mature in 30 years.

Denver, Col.—The City Engineer's plans for new sewers are said to involve an expenditure of $1,000,000.

Beatrice, Neb.—The $20,000 sewer bonds have been sold to W. J. Hayes & Sons, of Toledo, O.

Oakland, Cal.—Mr. HERING has presented a partial report of his proposed system of sewerage. It comprises four intercepting sewers to discharge into the estuary and a pumping works at West Oakland. His estimate of the cost is $879,000.

Street Work.—***Brooklyn, N. Y.***—Mayor CHAPIN has prepared a bill authorizing the issue of $1,000,000 in bonds during 1891 for carrying on the street improvement work.

Norfolk, Va.—The city will grade and curb several streets, and pave them with shells.

Moundsville, W. Va.—It is proposed to issue bonds for $20,000 for brick paving. Contractor ROSSER, of Bellaire, is figuring on the work.

Nashville, Tenn.—During the present year about $39,975 will be expended in granite paving.

Mobile, Ala.—On Dec. 30 a contract was made giving the Improved Wood Pavement Co., A. C. DANNER, President, the care of the streets and culverts of the city, for a term of five years, the contractor to lay 4,000 sq. yds. of wooden or of brick pavement per annum all for the sum of $31,000 per annum.

Gas.—The Empire Gas Lighting Co., of Huntington, L. I., is laying mains and building its works.—The Suburban Gas Co. has been incorporated at Chicago, by J. R. CUSTER, J. M. CAMERON, and J. A. GRIFFIN. Capital stock, $50,000.

Oakland, Cal.—Preparations are being made to take a vote on public improvements as follows:

Reclamation of the West Oakland marsh	$175,000
Deepening of Lake Merritt	175,000
Total for sanitary improvement	$350,000
Salt water pumping and distributing works	150,000
School purposes	175,000
Electric lighting	75,000
Total	$750,000

Water Power.—The Holyoke Water Power Co. will build a new dam across the Connecticut river at Holyoke, Mass. It will cost $750,000. Judge GIDEON, of Springfield, is president of the company.

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—The question of water supply for the villages on the shore front is being agitated. It is the most important question to come up at the next annual town meeting in March.

Somersworth and Rollinsford, N. H.—The directors of the Somersworth and Rollinsford Water Co. have appointed a committee to consider a basis of consolidation with the Berwick (Me.) Water Co.

Boston, Mass.—The City Treasurer has been directed to issue registered certificates of indebtedness for $100,000, at 3½ per cent. per annum, for extending the high service system of the Cochituate works. An order was also passed directing the fire commissioners to report on the cost and expediency of establishing a system of pipes in the business district, to be used in case of fire, water to be taken from the harbor and delivered at hydrants under pressure from a pumping station on the water front.

Taunton, Mass.—The Water Commissioners have announced that they will call on the city this year for an addition to the pumping plant. The driven well scheme has been abandoned, and no further experiments in this line will be made.

Newton, Mass.—At a recent meeting of both branches of the City Council (Newton and West Newton) orders were adopted authorizing the taking of land on Waban hill, a tract in the vicinity of Nahanton St., and land in Needham, for the purpose of increasing the water supply. Also authorizing the City Treasurer to pay $24,850 interest on water debt.

Waterbury, Conn.—A considerable amount of cast-iron pipe, with hydrants, valves, etc. will soon be wanted.

MIDDLE.

Binghamton, N. Y.—A new 12,000,000-gall. pumping engine, about 25 hydrants, 30 meters, and valves, will be needed this year.

Cohoes, N. Y.—An order has been passed by the City Council, providing for the drafting of a bill to be presented to the Legislature, authorizing the city to issue bonds for $20,000 for extensions and improvements.

Ellicottville, N. Y.—Subscriptions for $6,000 have been received for constructing works.

Brockport, N. Y.—Preliminary work is now being done. The works will be put in operation about Aug. 1. Bassett Bros., of Buffalo, N. Y., are the contractors. The Brockport Water Co. has been formed. President C. M. HARRINGTON; Secretary, E. M. BASSETT; both of Buffalo.

Cattaraugus, N. Y.—A public meeting was to be held on Jan. 6, to discuss the feasibility of putting in a system of water-works.

Holly, N. Y.—We have received the following information from E. M. BASSETT:

The Holly Water-Works Co. has been organized. C. M. HARRINGTON, President; E. M. BASSETT, Secretary; both of Buffalo. Capital stock, $45,000. The city will pay $1,125 per annum. Preliminary work is now being done. The works will be put in operation about Aug. 1.

Liberty, N. Y.—GEO. A. COWAN, Stamford, N. Y. says, "Expect to build at Liberty in the spring."

Plainfield, N. J.—The bond of the Water-Works Co. signed by JAMES MOORE, Chief Engineer of the Central R. R. Co., CHARLES K. MOORE, and ex-Congressman JOHN KEAN, Jr., has been accepted by the Common Council. The contract has been signed by Mayor JOB MALE and the members of the Council. The work of driving wells to test the supply of water has already been begun.

Keyport, N. J.—The Commissioners have decided to supply the town with water, and an appropriation of $1,000 has been guaranteed for experimenting with different methods. Artesian wells will probably be introduced.

Freehold, N. J.—The Committee in reporting on the experimental artesian well, state that it has been entirely satisfactory in demonstrating that a supply of wholesome water, sufficient for all the necessities of the town can be obtained by this means. The estimated cost of the projected works is $30,000 to $40,000. The Commissioners are: Chairman, JAMES S. YARD; WILLIAM MC DERMOTT; CHARLES TRUEX; WILLIAM H. BUTCHER and W. B. DUBYEE.

Philadelphia, Pa.—The Water Committee of the City Council has recommended the passage of an ordinance empowering the Mayor to lease for the city the water supply of the Schuylkill Water Co. for a period of 50 years, at an annual rental not exceeding, $300,000.

Elizabethville, Pa.—VIRGINIA B. HACKMAN has sent us the following:

The new works will probably be completed in July. Estimated cost, $8,000. The officers of the Elizabethville Well Co. are: H. H. WEAVER, President; C. B. STROUP, Secretary. Population, 1,200.

SOUTHERN.

Gainesville, Ga.—JAMES L. JOHNSON, of Atlanta, Ga., Engineer of the new works, sends us the following:

Contracts for boilers, pipe and specials, stand-pipe and trenching and pipe laying, are yet to be let. The works are being constructed under the supervision of the Mayor and City Council. The valves will be furnished by the Chapman Valve Mfg. Co., of Indian Orchard, Mass. The number of hydrants has not been decided upon. Estimated cost, $40,000. Population, 5,000.

Albany, Ga.—At the election held on Jan. 5, to vote on the question of issuing $50,000 of bonds for constructing works, 251 votes were cast for, and 99 against, their issue. Steps will probably be taken at once to establish works, as the city officials favor the improvement. Address Mayor MCINTOSH.

Columbus, Ga.—Steps are being taken by the Councilmen to require the company to purify the water now furnished for drinking purposes.

Cartersville, Ga.—Aubrey & McEwen have sent us the following information:

A $50,000 system of works has been constructed by the Cartersville Water Co. Water is pumped from a spring, and from the river to a stand-pipe of 125,000 galls. capacity. The city pays $2,500 per year for 50 hydrants. The officers are: Dr. BAXTER, Macon, Ga., and MARTIN COLLINS. Superintendent, M. A. DRIGGER.

North Knoxville, Tenn.—The city is willing to contract for 60 hydrants at $35 per year, but the company whose proposition is under consideration insists upon placing 86 hydrants. If the contract is not agreed upon, the artesian well plan will probably be tried.

Sherman Heights, Tenn.—Regarding the projected works W. A. WOOLSON sends us the following:

The water-works enterprise, with others, is still a matter for future development, but steps will undoubtedly be taken soon. The East Chattanooga Land Co. is interested. Water will probably be taken from a spring.

Paris, Ky.—The town voted a subscription to a company for constructing works eighteen months ago, which it is now willing to transfer to any reliable party who will establish a complete system of water supply. Stover and Houston Creeks surround the town, either of which would furnish an adequate supply of pure water.

NORTH CENTRAL.

Canton, O.—Extensions and additions amounting to $50,000 will be made this year. The improvements will include additional pumping machinery, 2 boilers, and a considerable amount of new mains.

Zanesville, O.—About 5,000 ft. of 24-in. pipe will be laid this season.

Greenville, O.—The question of securing a water supply has been agitated, but works will probably not be constructed until the natural gas plant is paid for. The present supply is from wells.

Lebanon, O.—Bids for the construction of water-works will be opened on Jan. 18. The plans and specifications call for a system costing about $50,000. The supply will be taken from artesian wells.

Leetonia, O.—Engineer J. B. STRAWN informs us that the new works have been completed and accepted. Total cost, $45,583.50.

Cincinnati, O.—Superintendent and Engineer ARTHUR G. MOORE informs us that the contract for furnishing and placing the Eden Park water tower has been awarded to Finnegan & Co. at $38,792.

Shelbyville, Ind.—The entire plant will be sold on Jan. 20 to satisfy a mortgage.

Waterloo, Ind.—Water will probably be pumped from wells to a tank or reservoir. ELI WILLIAMSON may be addressed.

Romeo, Mich.—We have received the following from B. N. SEAMAN:

A special election will probably be held about Feb. 1, and the outlook is that it will be carried in favor of constructing works. The village will give bonds for $45,000 or $50,000, payable in 30 years. The proposed plan is to pump water from Cusic Lake, 2¼ miles distant, to a stand-pipe.

Coldwater, Hudson and Howard City, Mich.—MARTIN E. AULSBROOK, of Sturgis, Mich., informs us that works will be constructed in these towns this year.

Howard City, Mich.—B. J. LOWRY has sent us the following:

M. Walker, of Fenton, Mich., has been awarded the contract for constructing works. Estimated cost, $10,000. The supply will be taken from wells. Population, 1,700. C. C. MESSENGER is Chairman of the Water Board. Population, 1,700.

Pinckneyville, Ill.—The new works have been tested and accepted by the city. At present the water is forced through the pipes by a pump, but as soon as required a stand-pipe will be erected at Breese Lake, from whence the water is taken.

Burlington, Wis.—Sealed proposals will be received until Jan. 30 for building a complete system of works. The artesian well, 1,008½ ft. deep, throws water 30 ft. above the surface.

Delavan, Wis.—Sealed proposals will be received until Jan. 20 for furnishing plans, specifications, proposals and bids for a franchise, to construct and operate a complete system of works. F. L. VON SUESSMILCH is President of the Water Committee.

Wauwatosa, Wis.—It is reported that the court-house and the county institutions are suffering from a lack of water. The county has water-works and a pumping station in this suburb for the benefit of those institutions. The present 6-in. pipe is sufficient to supply the asylums with water for their every-day use, but in case of fire it would be wholly inadequate. The county hospital and the old insane asylum are supplied with tanks and reservoir for the storage of water for cases of danger, but they have been declared ineffective by the State Board of Charities and Reforms. The County Board committee on County Water-Works and Asylums, has recommended the laying of new 14 or 16-in. pipe, at an outlay of from $6,000 to $10,000. The trustees of the insane asylums favor this proposition.

NORTHWESTERN.

Sioux City, Ia.—During the past year an independent main, 12 ins. diameter, was laid from the pumping station to the reservoir, at a cost of $12,515. The city did not extend its mains, but 5,337 ft. of 8-in., 350 ft. of 6-in. and 2,216 ft. of 4-in. pipe were laid by private parties, with the understanding that the city will acquire them as soon as an adequate revenue can be afforded; 65 hydrants were placed. Considerable work, including improvements to the wells and the laying of additional mains, is projected for the present year.—The West Side artesian well is now owned by Hattenbach & Magee, Sanborn & Follett and Judge Wakefield.

Onawa, Ia.—P. H. HOLBROOK states that it is not likely that any water supply enterprise will be undertaken for several years.

Alexandria, Minn.—The town has now ample fire protection, 30 driven wells having been put down.

Owatonna, Minn.—There is considerable agitation over the water-works question.

St. Paul, Minn.—The contract for supplying hydrants during the present year amounting to about $10,000, has been awarded by the Water Board to R. D. Wood & Co., of Philadelphia, and the contract for stop-cocks and valve boxes to the A. N. Morgan Mfg. Co., of Buffalo, N. Y. For furnishing valves to the Eddy Valve Co., of Waterford, N. Y.

Minneapolis, Minn.—The council committee on water-works has ordered water mains laid on Oak St, southeast for a distance of three blocks. City Engineer RINKER has been directed to prepare an amendment fixing the height to which water shall be pumped in high buildings, the committee believing that its adoption will result in a supply of tanks at all the high buildings.

Kansas City, Kan.—More hydrants are wanted in the suburban districts, and a more extensive fire department is also suggested.

McCook, Neb.—The plant has been sold to eastern capitalists.

Seward, Neb.—The well at the water-works is down to a depth of more than 300 ft., but water has not been reached.

Omaha, Neb.—A new syndicate is preparing to make propositions on the water supply question, and Mayor GRAHAM has been interviewed. A supply of 4,000,000 galls. of pure water per day is to be guaranteed.

Iroquois, So. Dak.—J. J. SWEET states that it is proposed to sink a 6-in. artesian well for power purposes; a pressure of 175 lbs. per sq. in. is expected.

SOUTHWESTERN.

Kansas City, Mo.—At a recent meeting of the finance committee of the upper house it was decided to report back the ordinance introduced by Alderman FORD appropriating $3,000 to make plans and estimates for the proposed new works with the recommendation that the appropriation be reduced from $3,000 to $1,000.

Denver, Col.—The following report of the City Engineer, estimating the cost of piping the water course from the Rocky Mountain ditch to the intersection of Scott St. and Gallup Ave., has been adopted by the City Council:

18-in. pipe, 2,365 ft. at 80 c.	$1,884.00
12-in. pipe, 4,900 ft. at 44 c.	2,156.00
Labor, excavation and laying pipe	1,722.50
Head gate, material and labor	100.00
Discharge valve and protection	225.00
At lower end	100.00
Superintendence and contingencies	302.50
Total	$6,000.00

Waco, Tex.—A new water supply system has been established by the Bell Water Co. at a cost of $200,000. President, J. D. BELL.

Vernon, Tex.—The following information is from JOHN BROWN, City Secretary:

A private company contemplates building works. Address D. A. TURNER. The population is 3,000.

Hillsboro, Tex.—It is reported that a stock company is being organized to sink an artesian well and construct a system of works.

Sherman, Tex.—It is reported that Z. P. Dederick will put in a pump of about 250,000 galls. capacity per 24 hours.

PACIFIC.

Fairhaven, Wash.—The contract for constructing works was to be awarded on Jan. 6. The supply will be taken from Lake Padden, 7 miles distant.

Pullman, Ore.—The City Council has instructed the committee on fire and water to investigate the probable cost of and report a plan for a system of works at the next meeting.

Portland, Ore.—Bonds for $50,000, running 30 years, 5 per cent. interest, have been sold to Beckman & Reames at $54,500. The money will be used in making extensions.

Oakland, Cal.—The Water Committee of the Board of Health, Dr. GEO. C. PARDEE, Chairman, has declared the water now being furnished as unwholesome, unsanitary, and injurious to health, and passed a resolution requesting the Board of Health to take steps to compel the company to properly purify it.—The Contra Costa Water Co. has given notice that the consent of the holders of two-thirds of the capital stock has been received to a proposition to change the principal place of business from Oakland to San Francisco.

Rock Springs, Wyo.—We have received the following letter from T. J. WYCKE, Superintendent:

On page 624 of your issue of Dec 28, 1889, I notice a very remarkable statement, under heading Rock Springs, Wyo. It is as follows: "The Water Committee of the Board of Health, Dr. GEO. C. PARDEE, Chairman, has declared the water now being furnished, as unwholesome, etc." There is no such person here as DR. PARDEE. The analysis of our water has put it above the average, for this section. There never has been any complaints from any source, of the water. I think the statement was a mistake and trust that you will rectify the same. [The note quoted referred to Oakland, Cal., and it was by error only that it appeared otherwise.—ED.]

Projects are reported at the following places:

Portsmouth, N. H., City Clerk.—Cottage City, Mass. H. J. GREENE.—Bel Air, Md., O. S. LEE.—Frostburg, Md., OWEN HUTCHENS.—Pulaski City, Va., L. F. CALFEE.—Atlanta, Ga., W. G. RICHARDS, Superintendent.—Fayetteville, Tenn., W. O. MORGAN.—Russellville, Ark., J. W. RUSSELL, Mayor.—Post Falls, I. T.

ARTESIAN WELLS.

Madison, Wis.—A well has been driven on the grounds occupied by the State fish hatchery, near this city. It is 60 ft. deep and overflows at the rate of 100 galls. per minute. By deeper boring it is hoped to get a larger flow.

Iowa.—Many deep wells are being bored in Osceola County.

Blair, Neb.—A well is to be sunk by the town.

Huron, Dak.—Work has been commenced on the second well, and it is expected to be completed by February 1.

Abilene, Tex.—The Abilene Progressive Committee has been organized. O. W. STEFFENS, President, will superintend the sinking of the artesian wells.

Sherman, Tex.—It is reported that additional wells will be sunk by Z. P. Dederick.

Las Cruces, N. M.—A subscription paper to secure money for sinking wells has been opened by the Rio Grande *Republican*.

IRRIGATION.

Red Bluff, Cal.—A petition of 57 land-owners for the organization of the Kirkwood Irrigation District has been presented to the Board of Supervisors, accompanied by bonds for $21,000, signed by FRANK HOUGHTON, O. E. MOORE and N. K. SPECT, and was passed unanimously. An election for directors will be held on Jan. 22. At least 50,000 acres of land are embodied in the survey, nearly all of which is capable of irrigation.

Medicine Lodge, Kan.—The Des Moines & Western Irrigation Co. has been incorporated at Topeka. The Directors are: E. W. HILL, C. C. ZIMMERMAN, H. A NOAH, and G. M. MARTIN. The capital stock is $25,000.

Orange City, Fla.—A plan is projected to bring the waters of Blue Spring to Orange City for irrigation.

Gering, Neb.—The Gering Joint Stock Co. has contracted with V. A. STOLBRAND, of Fort Collins, Col., to survey the route for an irrigating ditch which will virtually cover all the land south of the North Platte River in Scott's Bluff County. Construction will be commenced as soon as possible.

Albuquerque, N. M.—The address of Trimble & Co., mentioned in our last issue as contractors for the Rio Grande Irrigation & Colonization Co.'s ditch, is Boston, Mass.

Salt Lake City, Utah.—Articles of incorporation of the Hydraulic Canal Co. have been filed. The corporation is to exist for 50 years, and is formed for the purpose of constructing and maintaining a canal to convey water for agricultural purposes and to purchase and erect hydraulic machinery for the raising of water out of the Jordan River into the canal, which is to be operated from a point near the dam in the Jordan River, near the southern boundary of this county.

The following are named as directors: J. R. WINDER, JOSHUA MIDGELY, ALONZA YOUNG, C. S. BURTON, JOHN NICHOLSON, E. A. SMITH and W. J. LEWIS.